GaGe

CompuGen PCI Hardware Manual and Driver Installation Guide

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- Brand name and type of computer
- Processor and bus speed
- Total memory size
- Information on all other hardware in the computer

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Table of Contents

Preface iii

Preventing ESD 1

General safety summary 2

Fundamental concepts 3

Identifying your CompuGen PCI card 4

Driver installation guide 5
- CompuGen PCI Driver Installation 5

Installing a CompuGen PCI card (does not apply to CompuGen ISA cards) 7

CGTest software guide 11
- General CGTest Operation 11
- Generation Modes 13
- Waveform Configuration in CGTest 14
  - Function Mode 14
  - Arbitrary Waveform Mode 15
- Determination of Actual Waveform Length 16

What you should receive with your CompuGen 4300 17

CompuGen 4300 product introduction 18
- 4 Simultaneous Output Channels 18
- 300 MHz Conversion Rate 18
- Output Range 18
- Generation Modes 18
  - Free Run Mode 18
  - Triggered Mode 18
- External Clock 19
- External Trigger 19
- Digital Output Marker 19
- Link'n'Loop 19
- Multi-Card Systems 19

CompuGen 4300 specifications 20

CompuGen 4300 ordering information 23

CompuGen 4300 block diagram 24

CompuGen 4300 connectors 25

CompuGen 4300 attenuator 26

What you should receive with your CompuGen 8150 or CompuGen 8152 27

CompuGen 8150 and CompuGen 8152 product introduction 28
- 8 Simultaneous Output Channels 28
- 150 MHz Conversion Rate 28
- Output Range 28
- Generation Modes 28
  - Free Run Mode 28
  - Triggered Mode 28
- External Clock 29
- External Trigger 29
- Digital Output Marker 29
- Link'n'Loop 29
- Multi-Card Systems 30

CompuGen 8150 and CompuGen 8152 specifications 31

CompuGen 8150 and CompuGen 8152 ordering information 34

CompuGen 8150 and CompuGen 8152 block diagram 35

CompuGen 8150 and CompuGen 8152 connectors 36

What you should receive with your CompuGen 11G **37**
CompuGen 11G product introduction 38
1 GHz Conversion Rate 38
Output Range 38
Generation Modes 38
Free Run Mode 38
Triggered Mode 38
External Clock 39
External Trigger 39
Digital Output Marker 39
Link’n’Loop 39
Multi-Card Systems 39
CompuGen 11G specifications 40
CompuGen 11G ordering information 43
CompuGen 11G block diagram 44
CompuGen 11G connectors 45
CompuGen 11G external clock jumper configurations 46
JP2 (pinout) 46
Clock configuration table 46
External clock input notes 46

Technical Support **47**

GaGe products **48**

Preface

This manual provides detailed information on the hardware features of CompuGen PCI Analog Output cards. This information includes specifications, block diagrams, connector descriptions, and memory architecture descriptions.

In addition, this guide takes you through the process of installing your CompuGen card(s) and describes available features.

Please note that this manual is not intended as a reference for CompuScope cards or CompuGen ISA 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 PCI bus 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 periodically.

Note: For brevity, in this manual,

“CompuGen 4300” is abbreviated as “CG4300”

“CompuGen 8150” is abbreviated as “CG8150”

“CompuGen 8152” is abbreviated as “CG8152”

“CompuGen 11G” is abbreviated as “CG11G”

Preventing ESD

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

⚠ **CAUTION.** *Static 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, that 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.

Fundamental concepts

Arbitrary waveform generation is the superior method of modern high-speed signal generation. While traditional analog signal sources may provide higher fidelity generation of a very limited class of signals (such as sine waves), modern arbitrary waveform generators provide the flexibility to generate any signal imaginable!

Arbitrary waveform generation technology is based on the fact that a waveform can be represented by sequential discrete values of its amplitude. The representation of a waveform improves with a larger number of discrete values per waveform cycle and with a larger the number of bits in the integer value representing the amplitude. An ideal scheme would provide an infinite number of discrete values per waveform cycle and an infinite number of bits representing waveform values.

On an arbitrary waveform generator, the clock rate determines the conversion frequency of discrete values into analog output voltages. A sequence of discrete values is stored in memory and clocked out to a Digital-to-Analog Converter (DAC). The clock rate determines the conversion frequency of these discrete values into analog voltages and thus the signal frequency. The same digital pattern in memory can produce a waveform of different frequency by changing the clock frequency. The inherent advantage of digital to analog conversion technology is that a digital pattern, and therefore any arbitrary waveform, may be created by software and then uploaded to the DAC memory. Consequently, any digital pattern may be created with the appropriate software.

The power of arbitrary waveform generation enables the easy computer-based creation of real life, non-periodic, asymmetric signals. It is possible to easily simulate real signals, with noise, jitter, spikes, and other signal anomalies simply by writing down their defining equation.

The GaGe CompuGen family of PC-based arbitrary waveform generators offers a wide range of channel counts and output rates to suit a variety of applications. Software Development Kits (SDKs) enable the user to easily create and tailor waveforms to suit application requirements.

Identifying your CompuGen PCI card

For future reference, you should record the following information about your card on the copyright page found at the front of this guide.

CompuGen PCI model

The CompuGen model number can be found on the bottom-right corner of the card as shown below. In this example, we are using a CompuGen 4300.

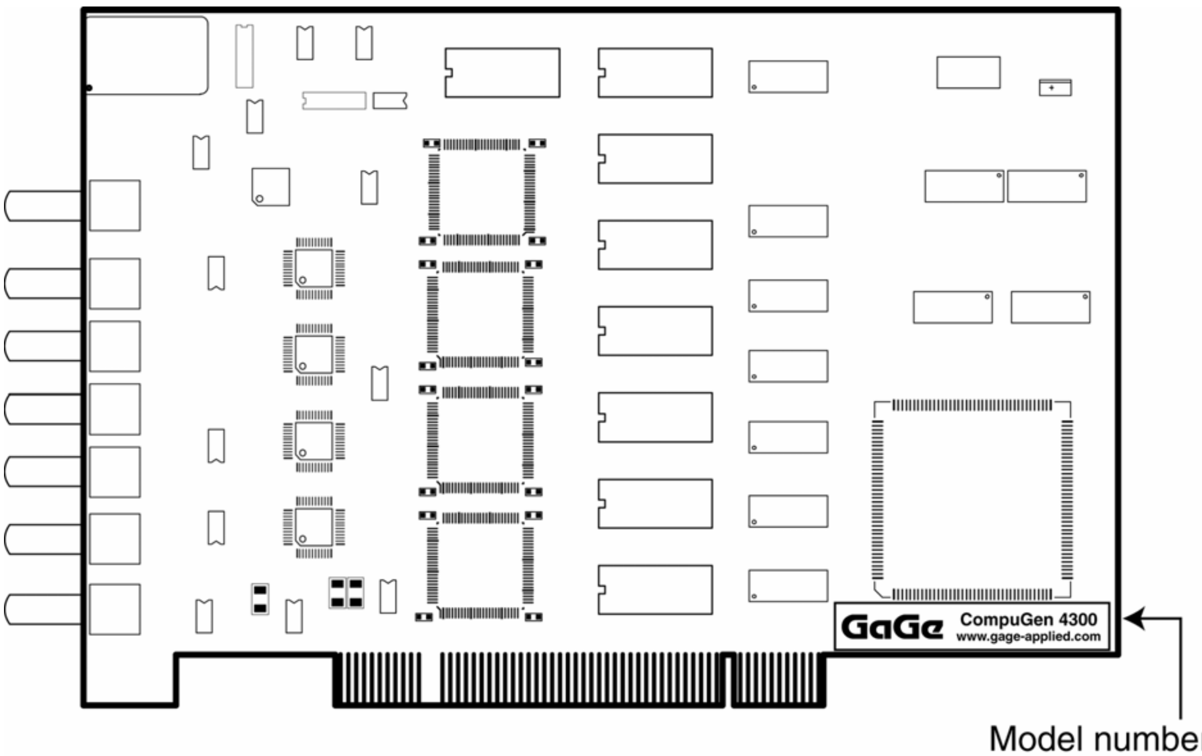


Figure 1: CompuGen PCI Model Number

Driver installation guide

This section describes how to install the drivers and software for your new CompuGen PCI 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. These discrepancies are not important.

CompuGen PCI Driver Installation

Insert the GaGe Software Disk containing the CompuGen PCI Drivers into your CD drive. Navigate to your CD drive and double-click on the setup.exe file to start the installation. Please note that it will NOT AutoRun.

The CompuGen PCI Driver installation is a standard install. The most important screens of the CompuGen PCI Driver Install Wizard are shown below.

Figure 2: First screen of the CompuGen Install Wizard

By default, the drivers will be installed in the O/S system drive:\Program Files\Gage\CompuGen\ directory. Alternately, you can choose a destination directory of your preference.

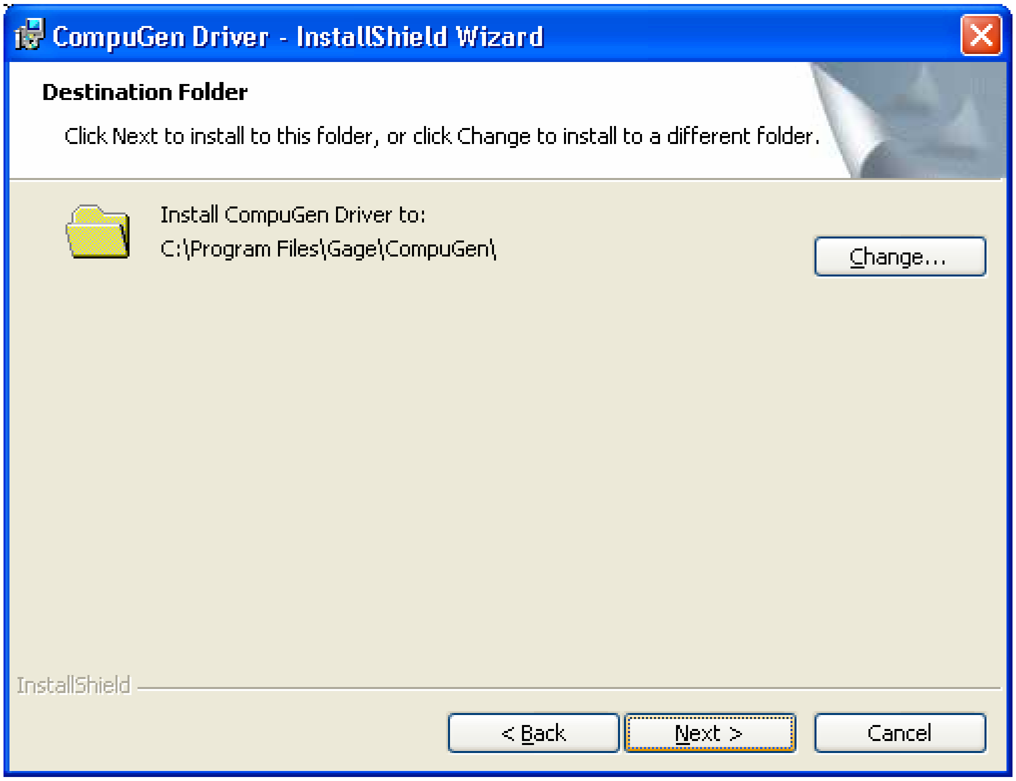


Figure 3: Destination folder screen of the CompuGen Install Wizard

In order to proceed with the installation of the CompuGen hardware, you must shut down your computer. Once the CompuGen PCI driver has been installed, you will be asked whether you want to restart your computer immediately, or you may choose to restart your computer later. Please note that you will need to fully power down your PC in order to install your CompuGen PCI hardware. Select No to avoid a superfluous restart.

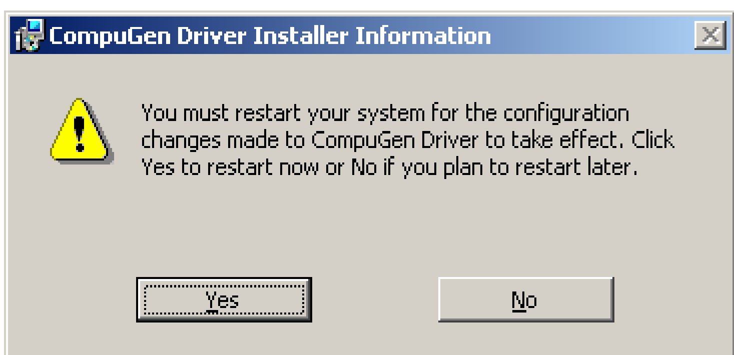


Figure 4: Last screen of the CompuGen installation

After installing the drivers, proceed with the installation of your CompuGen hardware. The CGTest software and CompuGen PCI SDKs are installed during the installation of the CompuGen PCI Windows drivers. They will be ready to use once you have installed your CompuGen hardware.

Installing a CompuGen PCI card (does not apply to CompuGen ISA cards)

These hardware installation instructions are for the following CompuGen PCI cards: CompuGen 4300, CompuGen 8150, CompuGen 8152, and CompuGen 11G.

Please refer to page 1 for Electrostatic Discharge (ESD) handling procedures before installing your CompuGen card(s).

1 Refer to the section within this manual called *Driver installation guide* on page 5 for instructions on installing Windows drivers for the CompuGen PCI card.

   You must install the Windows drivers for your CompuGen PCI card prior to installing the CompuGen hardware in your PC. Windows drivers are supplied with the product on CD.

2 Once the CompuGen PCI Windows drivers have been installed, power off your PC.

3 Open your PC's cover.

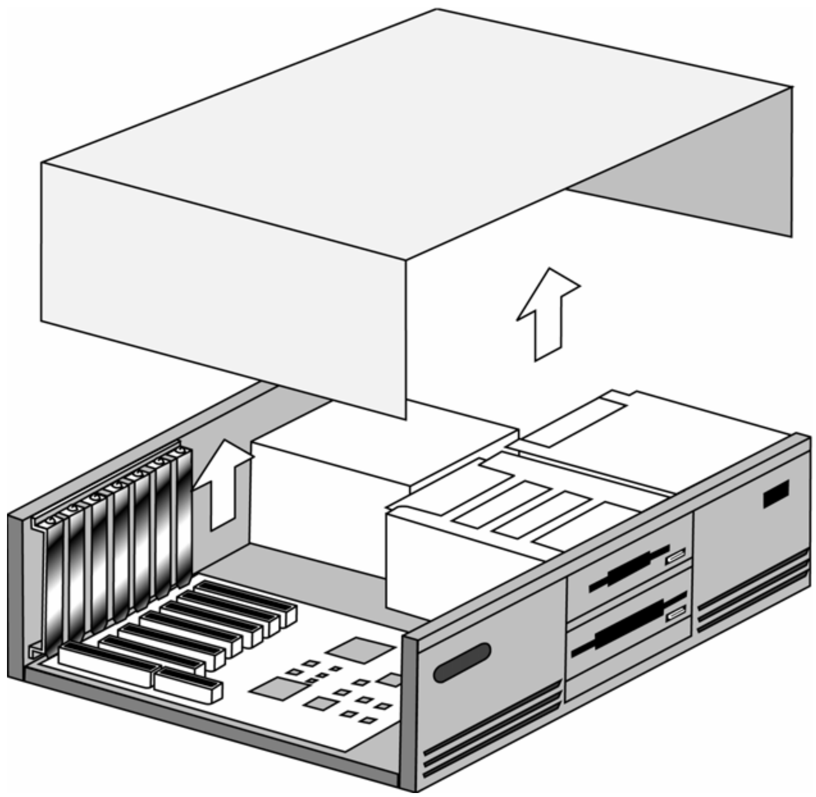


Figure 5: Opening your PC's cover

4 Select an unused full- or mid-sized 5 Volt PCI expansion slot.

Please note: If you are installing a CompuGen 8150 or CompuGen 8152 and will be using the auxiliary connector bracket, you will need a full- or mid-sized PCI expansion slot for the main card and an adjacent slot or bracket location for the auxiliary connector bracket.

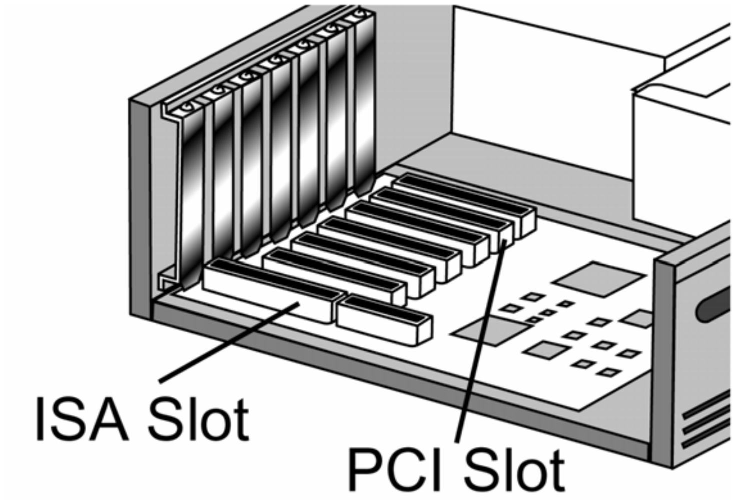


Figure 6: Selecting a PCI slot

5 Unscrew the screw holding the slot's backplate and remove it. Keep the screw, as you will need it in subsequent installation steps.

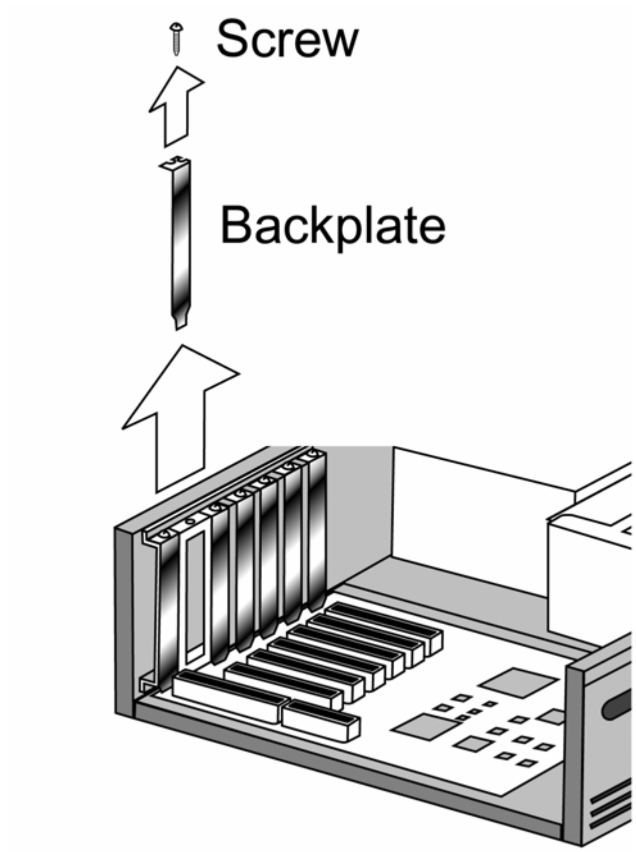


Figure 7: Removing the backplate

6 **Step for CompuGen 4300, CompuGen 8150 or CompuGen 8152 without auxiliary connector bracket, or CompuGen 11G:**

The CompuGen 8150 and CompuGen 8152 can be used without the auxiliary connector bracket if you do not require external triggering, external clocking, or digital output functionality. If you are installing a CompuGen 8150 or CompuGen 8152 with the auxiliary connector bracket, please proceed to step #7.

If you are installing a CompuGen 4300, a CompuGen 8150 or CompuGen 8152 without the auxiliary connector bracket, or a CompuGen 11G, simply insert the card into the empty slot and proceed to step #8.

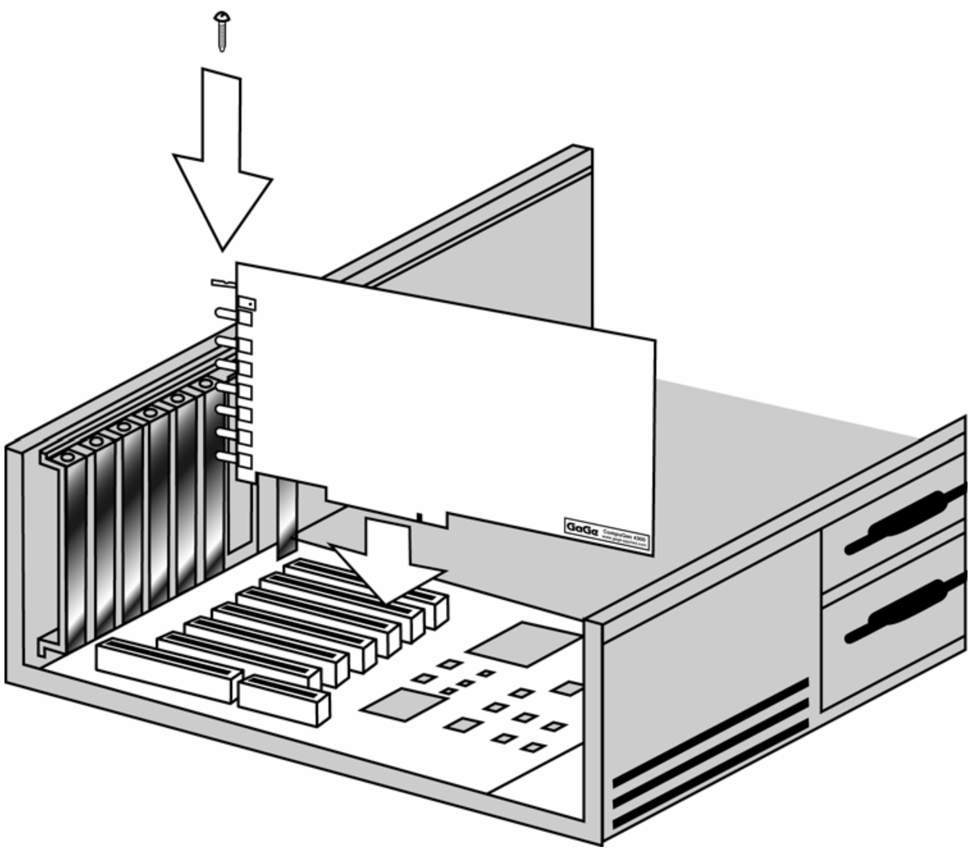


Figure 8: Inserting a single CG4300, CG8150 or CG8152 (without auxiliary bracket), or CG11G

7 **Step for CompuGen 8150 or CompuGen 8152 when using auxiliary connector bracket:**

If you are installing a CompuGen 8150 or CompuGen 8152 with the auxiliary connector bracket, you must first make the physical connections between the CG8150/CG8152 and the auxiliary connector bracket. The auxiliary connector bracket comes with three mini coaxial cables attached. Please connect the male SMA connectors on the end of each coaxial cable to the appropriate female SMA receptacle on the CG8150/CG8152. The length of each cable indicates its corresponding receptacle, as shown in the diagram below. Next, insert the main card into the PCI slot and insert the auxiliary bracket into an adjacent bracket location.

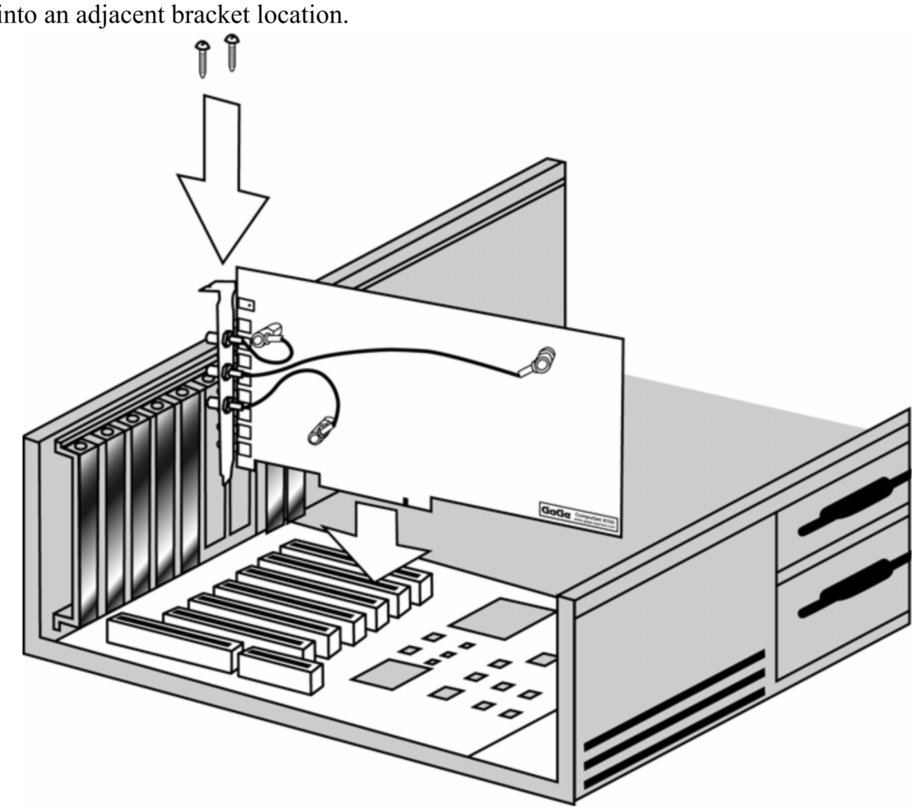


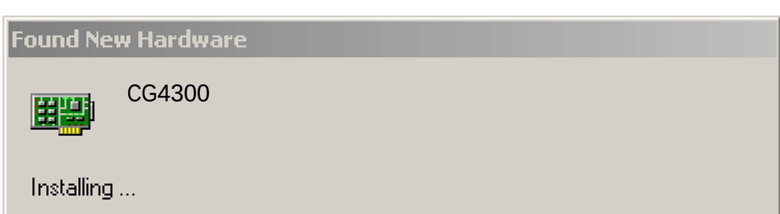
Figure 9: Inserting a single CG8150 or CG8152 with the auxiliary connector bracket

8 After making sure that the card is properly seated, screw the card to the chassis.

Please note: If you are installing a CompuGen 8150 or CompuGen 8152 with the auxiliary connector bracket, you must also screw in the auxiliary bracket.

9 Repeat steps as necessary if installing more than one CompuGen PCI card.

10 Close the PC's cover and turn the main power switch back to ON. Provided that you have installed your CompuGen PCI drivers prior to installing your CompuGen PCI hardware, the card will be recognized by your PC once Windows starts-up.



11 Proceed to the section *CGTest software guide* on page 11 for instructions on operating your CompuGen PCI card using CGTest.

12 **(Optional)** When writing your own program using one of the GaGe Software Development Kits (SDKs), please refer to the CompuGen PCI SDK manual for information on usage of the SDK.

CGTest software guide

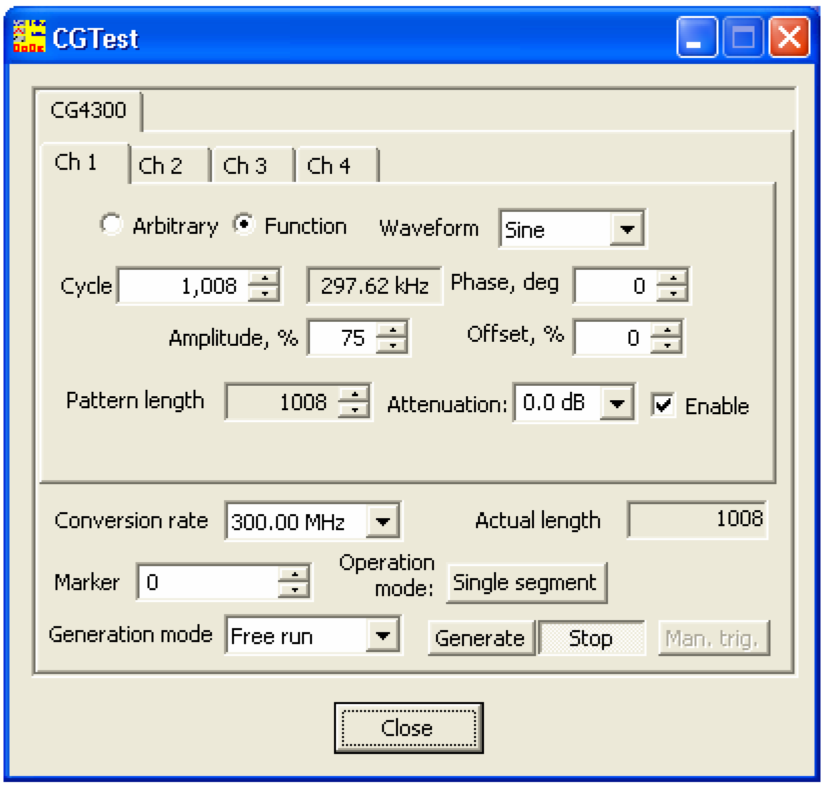
This section shows you how to use the CGTest software that was installed with your CompuGen PCI Windows drivers.

CGTest is able to generate simple repetitive waveforms (sine, square, triangle) in addition to a previously constructed arbitrary waveform. Front panel controls allow easy CompuGen parameter adjustment and operation control.

General CGTest Operation

To run CGTest, select CGTest from the **Start → Programs → Gage** menu.

When CGTest starts, you will see the following window. CGTest will detect any and all CompuGen PCI cards that you have installed in your PC, and show you all the available channels for each card. In this example, we are using a CG4300.

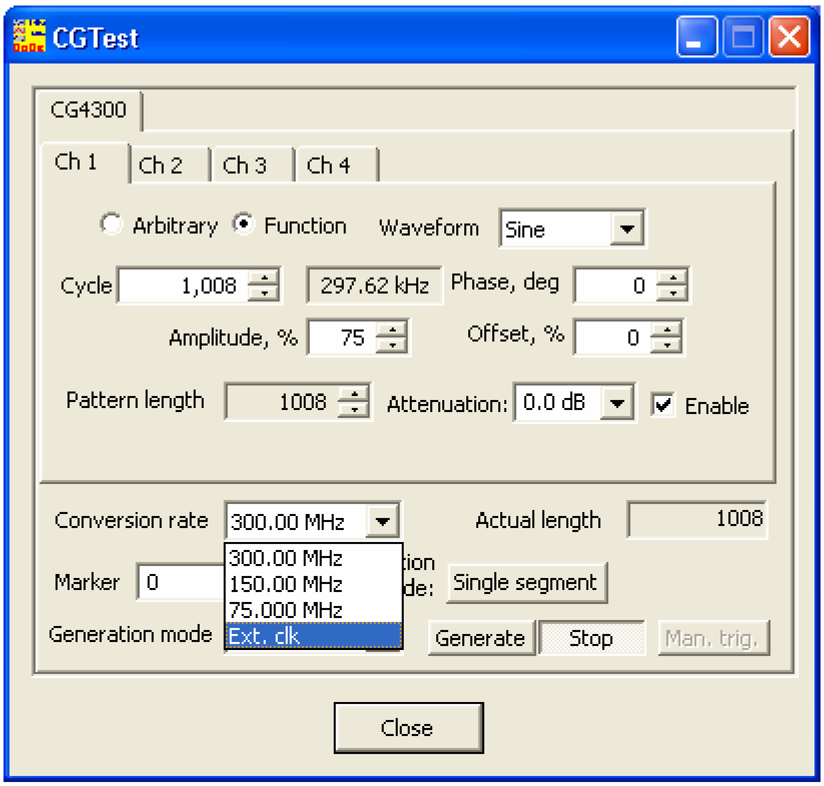


There are two methods of waveform configuration in CGTest: Function Mode and Arbitrary Waveform Mode. We will explain the two methods in detail later on in this section. First, we will describe the controls that are common for both methods of waveform configuration.

You can adjust the controls for any one of the channels on your CompuGen PCI card by selecting the appropriate channel tab. In order to actually generate a waveform, you must enable the channel by using the **Enable** checkbox. Channel 1 is enabled by default and any other available channels are disabled by default.

The controls that appear on the bottom third of the CGTest window govern the overall operation of the CompuGen PCI hardware, and so apply to all output channels.

You can change the conversion rate by making a selection from the **Conversion rate** pull-down menu. Please note: When selecting External Clock (Ext.clk), you must make sure that your external clocking signal is connected to the CompuGen card's external clock input connector. Furthermore, you must ensure that your clocking signal conforms to the external clocking requirements of your CompuGen PCI card. The external clocking requirements are listed in the product specifications.



The **Actual Length** indicator displays the actual length of the generated waveform. The actual length is specified in samples so that the waveform duration can be calculated by dividing the actual length by the conversion rate. For example, a waveform with an actual length of 600 points that is generated at a conversion rate of 300 MHz will have a duration of 600 ÷ 300 MHz = 2 microseconds. As described later, determination of the actual length is dependent upon the number of active channels and upon the waveform configuration method.

Clicking on the **Close** button terminates all waveform generation and exits CGTest.

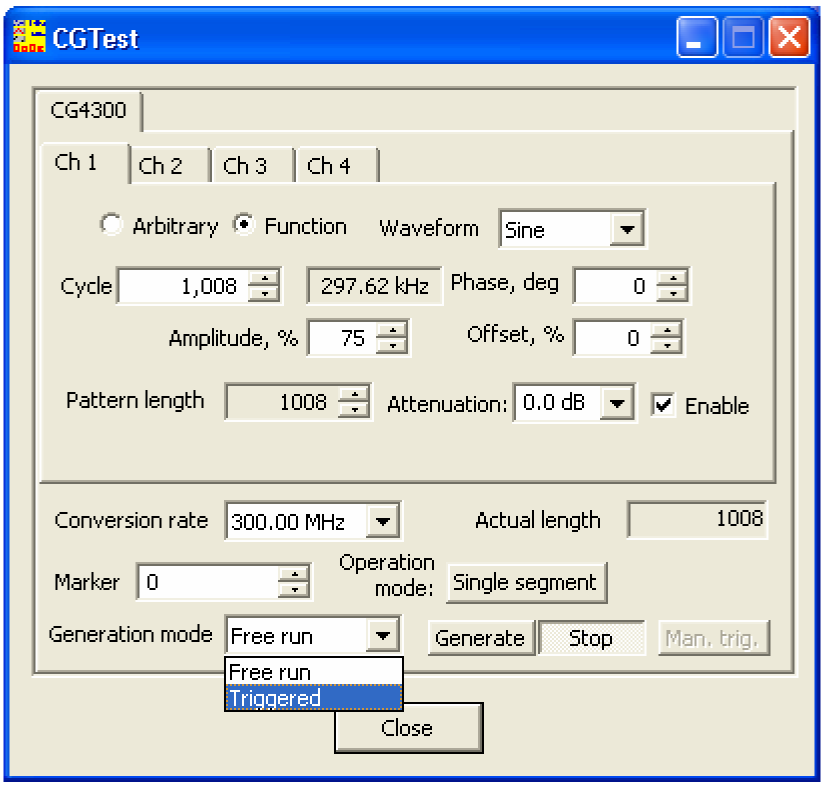
Generation Modes

The CompuGen card can be operated in two generation modes: Free Run Mode and Triggered Mode. You can select either **Free run** or **Triggered** from the **Generation mode** pull-down menu. For more information on the Free run and Triggered generation modes, refer to the section *Generation Modes* on page 18, 28, or 38.

In Free Run Mode, only the **Generate** and **Stop** buttons are active. **Generate** will start continuous, repetitive waveform generation. Clicking on **Stop** will immediately stop waveform generation.

When you select **Triggered** from the **Generation mode** pull-down menu, operation of the **Generate** button changes slightly. When the **Generate** button is clicked, the CompuGen card is armed to await repetitive external trigger events. Generation of a single waveform is initiated by a single trigger event. After generation of a waveform, the CompuGen card rapidly re-arms itself to await another trigger event.

A Trigger event is defined as the detection of a rising TTL signal edge on the external trigger input OR the action of clicking the **Man.Trig.** button, which becomes active in Triggered Mode. Both external trigger events and clicking the **Man.Trig.** button are processed identically and both initiate generation of a single waveform. Pressing the **Stop** button aborts all waveform generation.



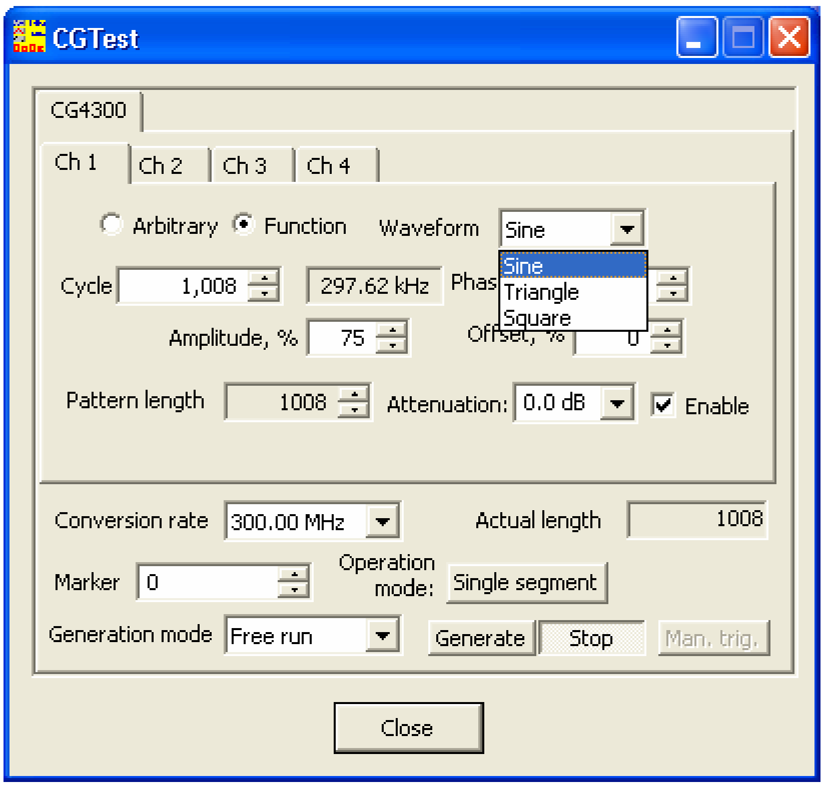
Waveform Configuration in CGTest

There are two methods of waveform configuration in CGTest: Function Mode and Arbitrary Waveform Mode. You can switch between the two modes by selecting the **Function** or **Arbitrary** radio buttons. The default setting for all channels is Function Mode.

Function Mode

Function Mode allows the generation of three simple waveforms: a sine wave, a square wave, and a triangle wave. Control of the parameters governing the creation of waveforms in Function Mode appear in the top two-thirds of the CGTest window and are described below.

The default waveform configuration method is Function Mode. You can change the type of waveform generated by making a selection from the **Waveform** pull-down menu.



Cycle – Length of the waveform cycle in points. The resulting waveform frequency is displayed to the right of the control. The waveform frequency is calculated simply as the conversion rate divided by the number of points in the cycle. Since the external clock rate is not known by CGTest, the signal frequency is not displayed in external clock mode.

Amplitude, % – The amplitude of the waveform relative to full scale (span = 25%-100%)

Phase, deg – Initial phase of the waveform in degrees (span = 0-359)

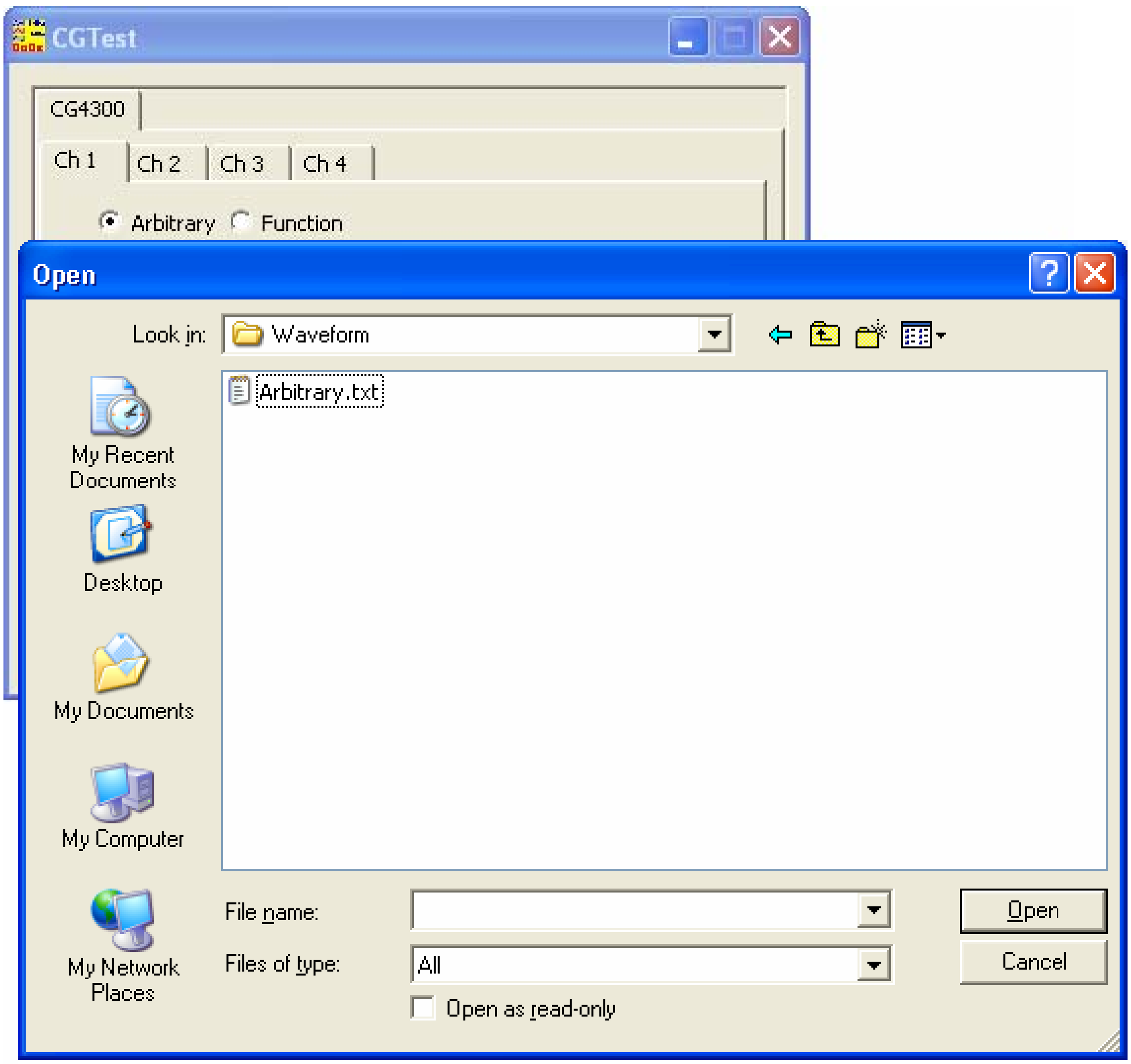
Offset, % – DC offset of the waveform relative to full scale (span = ±100%)

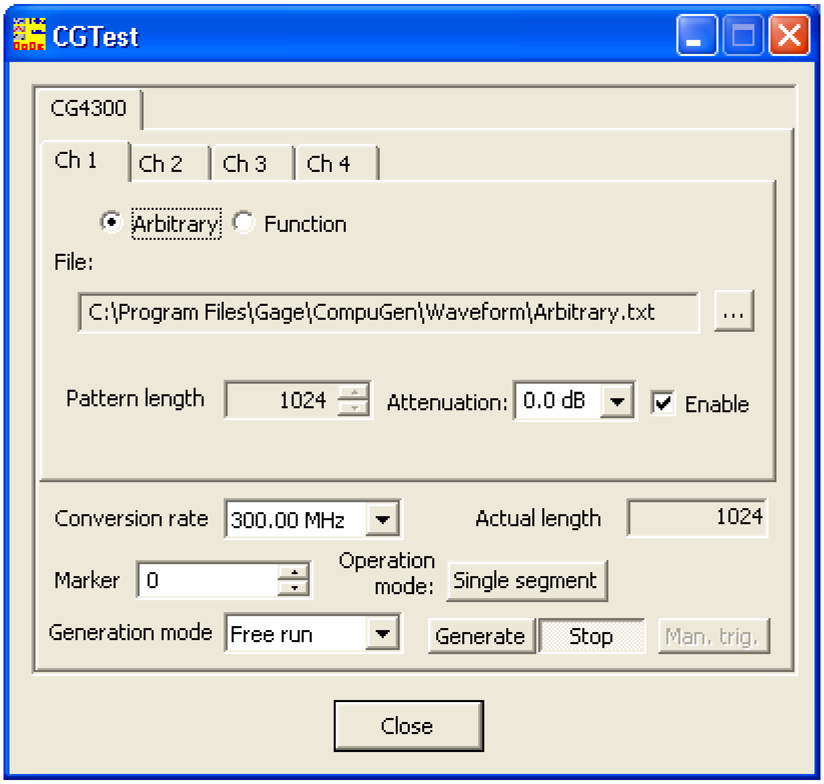
Pattern Length – In Function Mode, the pattern length is adjustable in increments equal to the number of points in the cycle. By adjusting the pattern length, therefore, you can create a waveform with an integral number of cycles.

Arbitrary Waveform Mode

Arbitrary Waveform Mode allows the generation of completely arbitrary waveforms that have been previously constructed as ASCII text files. These text files may have been prepared using a powerful equation editor such as Microsoft Excel.

You can select Arbitrary Waveform Mode by clicking on the **Arbitrary** radio button. You will then be prompted to load a custom waveform file. Please note that waveform file must be a .txt file containing one column of data values between 0 and 4095. 0 corresponds to positive full scale, 4095 corresponds to negative full scale, and 2048 corresponds to 0 Volts. The total number of data values should be a multiple of 16 and be at least 64 points.





Once you have selected a .txt file, the complete file name is displayed in the **File:** indicator.

To the right of the file indicator is a browse button (), which allows selection of another .txt file.

Pattern Length – In Arbitrary Waveform Mode, the pattern length is not adjustable and simply indicates the number of points on the currently loaded .txt file.

Determination of Actual Waveform Length

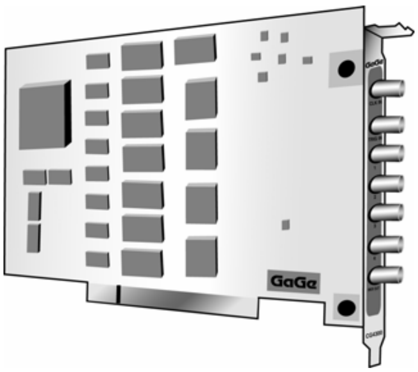
The waveforms generated on all enabled channels will always contain the same number of points, and will be generated at the same conversion rate. The number of points in all generated waveforms is displayed in the **Actual length** indicator. Although all generated waveforms will have the same length, the length of the patterns created on different channels may have different lengths, as shown in the **Pattern length** indicator for each channel. In the event that pattern lengths vary amongst different channels, CGTest will limit the actual length to the shortest pattern length amongst all enabled channels.

For instance, let us assume that the pattern created on channel 1 is a single sine wave cycle with a cycle length of 1000. The pattern length on channel 1 is therefore 1000. Furthermore, suppose that an arbitrary waveform with a pattern length of 800 points has been loaded on channel 2. If both channel 1 and channel 2 are enabled, CGTest will select the smaller of the two pattern lengths and will display an actual length of 800. Please note that in this example the 1000 point sine wave cycle will be truncated to 800 points. Consequently, if the CompuGen card is operated in Free Run Mode, the sine wave output on channel 1 will be distorted since only 80% of the cycle is repeated. In order to avoid this distortion, the user may add two-hundred 0s at the end of the .txt file that was loaded on channel 2 (zero-padding).

What you should receive with your CompuGen 4300

If you order a CompuGen 4300 card, you should receive the following articles:

- One CompuGen 4300 card



- Standard items included with each CompuGen 4300 card

Gage CompuGen PCI Drivers, CGTest software, and CompuGen PCI SDKs

The GaGe Software Disk contains the software drivers you need to operate your CompuGen PCI hardware. It also contains the CompuGen PCI Hardware Manual and Driver Installation Guide, in PDF format.

This CD also contains the CGTest software, as well as the C/C++, LabVIEW, and MATLAB SDKs for your CompuGen PCI cards.

Warranty card

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 CompuGen card.

CompuGen 4300 product introduction

The CompuGen 4300 is a 300 MHz, 4-channel, 12-bit analog to digital waveform generator card for the PCI bus. The CompuGen 4300 is a fully Plug'n'Play-compliant PCI card. Its main performance features are:

- 300 MHz maximum digital-to-analog conversion rate
- 12-bit DAC resolution
- A 4 MegaSample (MS) on-board memory buffer shared equally among 4 channels (1 MS per channel)
- Multi-card operation for up to 16 output channels

CompuGen 4300 feature description:

- **4 SIMULTANEOUS OUTPUT CHANNELS**
  The CompuGen 4300 is equipped with 4 high-speed 12-bit Digital-to-Analog Converter (DAC) chips. Each DAC chip is clocked by the same conversion clock signal for simultaneous generation on all 4 channels. While each of the 4 channels may generate its own distinct waveform, corresponding samples from each waveform are generated simultaneously. This simultaneous clocking of all 4 channels is crucial for the generation of phase-sensitive signals such as: the simulation of 3-phase power signals, and the simulation of In-phase and Quadrature (I&Q).

- **300 MHz CONVERSION RATE**
  The CompuGen 4300 uses a high-quality Digital-to-Analog Converter (DAC) that operates at a maximum clock frequency of 300 MHz - a new sample is output every 3.33 nanoseconds.

  An on-board crystal oscillator ensures timebase accuracy and long-term thermal stability.

- **OUTPUT RANGE**
  The CompuGen 4300 provides an output of ±0.87 Volt into a 50 Ω load. For smaller signal generation, the CompuGen 4300 is equipped with a software-programmable output attenuator that allows up to 31.5 dB attenuation of the normal signal in ½ dB increments. The output stage has a high slew rate. The 12-bit vertical resolution means that up to 4096 different discrete output voltage levels may be generated.

  The CompuGen 4300 expects a 50 Ω load so that 50 Ω coaxial cables are correctly impedance-matched and signal reflections are eliminated. If, however, a high impedance load is used, the output voltage will double so that the ±0.87 Volt output range becomes a ±1.74 Volt output range.

- **GENERATION MODES**
  The CompuGen 4300 may be operated in two distinct generation modes: Free Run Mode and Triggered Mode.

  - **FREE RUN MODE**
    Free Run Mode is provided for the generation of continuous repetitive signals with the CompuGen 4300. In Free Run Mode, the on-board memory of the CompuGen 4300 is seamlessly and endlessly looped during signal generation. For example, a single cycle may be uploaded to CompuGen 4300 memory and looped in order to create a continuous sine wave signal.

    In Free Run Mode, signal generation is initiated from software. For instance, from the CGTest signal generation software, generation is initiated by the click of a button. Alternatively, a user-developed program may initiate signal generation upon occurrence of some other timed event.

  - **TRIGGERED MODE**
    In Triggered Mode, the CompuGen 4300 is configured to generate its pre-programmed waveform in a single-shot fashion - once every time a trigger event occurs. The trigger circuitry is automatically re-armed in hardware after single-shot waveform generation in order to await another trigger event. Since it is done in hardware with no software interaction required, trigger re-arm is lightening-fast. By issuing multiple triggers, therefore, the user can easily create waveform bursts.

    The source of the trigger event can be a software trigger or an external trigger signal. Using external triggering, the CompuGen 4300 generates a single-shot waveform upon receipt of the rising edge of a

TTL pulse at the external trigger input. Using software triggering, the generation of a single-shot waveform occurs when a software command is issued.

- **EXTERNAL CLOCK**
  External clocking functionality is a standard feature of the CompuGen 4300. External clocking allows the user to clock the DAC directly with a supplied clocking signal. This is necessary when signal generation must be synchronized with an external reference signal.

  In External Clock Mode, a new sample is generated by the CompuGen 4300 upon every rising edge of the supplied TTL clocking signal. This direct external clocking method is preferred since alternate methods that employ Phase-Lock-Loop (PLL), or re-clocking circuitry can lead to missed or extra clock pulses.

  The external clocking signal must be a TTL signal with 50% duty cycle. The user must ensure that the external clocking frequency is between 1 MHz and 300 MHz.

- **EXTERNAL TRIGGER**
  The CompuGen 4300 comes equipped with an SMA external trigger input. The external trigger input is used only when the CompuGen card is operated in Triggered Mode. In Triggered Mode, the CompuGen card generates a single-shot waveform upon receipt of the rising edge of a TTL pulse at the external trigger input.

- **DIGITAL OUTPUT MARKER**
  The CompuGen 4300 comes equipped with an SMA connector that provides a digital Output Marker signal. The Marker output produces a TTL signal with a TRUE level of 1.3 V and a FALSE level of 0 Volts, assuming 50 Ohm terminating impedance. The main usage of the Marker Output is for creating digital signals that may be used as external trigger source for other devices, such as a CompuScope digitizer card. Software control allows placement of a Marker pulse that is 4 samples wide and that occurs during pattern generation. The Marker position may be specified with a resolution of 4 samples anywhere within the CompuGen pattern. The Marker position value specifies the position of the falling edge of the Marker Pulse. For instance, consider a pattern of length 8192. A Marker position of 0 will cause the Marker output to generate a digital Marker pulse at the beginning of the pattern. Similarly, a Marker position of 4096 will create an Output Marker pulse in the middle of the pattern, while a Marker position of 8180 will create a Marker pulse near the end of the pattern.

  CGTest is equipped with a digital control that is used to position (with a resolution of 4 samples) a marker pulse at any time during output waveform generation.

  Output Marker positioning is similarly controllable from any CompuGen SDK.

- **LINK’N’LOOP**
  The CompuGen 4300 supports Link’N’Loop Mode, which allows multiple pattern segments to be uploaded to the CompuGen’s on-board memory for later selective generation. Link’N’Loop Mode is significantly more complex than normal CompuGen mode and so should be used only by users who are already comfortable with normal CompuGen operation. Link’N’Loop Mode is accessible using only the CompuGen Software Development Kits and so is comprehensively documented within the CompuGen SDK manual.

  The advantage of Link’N’Loop Mode is that waveforms need not be sequentially uploaded to the CompuGen card during a generation session. Instead, waveform segments may be preloaded onto the CompuGen 4300 and then the user may rapidly switch between different segments during generation. In Link’N’Loop Mode, the CompuGen on-board memory is segmented and filled with waveform segments of equal length. As an example, with the CompuGen 4300, which has 1M of pattern memory per channel, up to 1024 waveform segments of 1024 points each may be pre-loaded into CompuGen memory for later generation. Different triggering and looping conditions may be pre-selected for each Link’N’Loop segment. Segment configurations are pre-loaded so that, during generation, the user may switch between different waveform segments with no software interaction required.

- **MULTI-CARD SYSTEMS**
  Up to 4 multiple/independent CompuGen 4300 cards can be installed if more than four output channels are needed. PCs with up to 16 high-speed output channels can therefore be configured.

CompuGen 4300 specifications

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

SYSTEM REQUIREMENTS

PCI bus compatible PC with at least one free PCI slot, 128 MB RAM, 50 MB hard disk and SVGA video.

SIZE

Single-slot mid-sized PCI card

POWER REQUIREMENTS

+5 V	2.5 Watts*
+3.3 V	8.4 Watts*
+12 V	2.6 Watts*
-12 V	1.2 Watts*

Total = 14.65 Watts. (*using worst-case waveform on all channels)

DIGITAL TO ANALOG CONVERSION

Outputs:	4 per card
Output Range:	±0.87 V (1.74 Vp-p) single-ended output into 50 Ω On-board programmable attenuator with up to 31.5 dB attenuation in ½ dB increments
Output Coupling:	DC
Output Impedance:	50 Ω
Resolution:	12 bits
Accuracy:	±3% excluding offset
Analog Output Bandwidth:	Better than 100 MHz
Connector:	SMA
Generation Modes:	Free Run Mode (continuous looping) Triggered Mode (single-shot)
Conversion Rates:	300 MHz, 150 MHz, 75 MHz
Memory Buffer Depth:	4M samples total, 1M per channel
Record Length:	16 samples minimum 1M samples maximum
Record Length Increment:	16 samples
Output Frequency:	150 MHz to 75 Hz
Rise Time:	2.5 nanoseconds, typical
Fall Time:	2.5 nanoseconds, typical

CRYSTAL OSCILLATOR STABILITY

Long Term:	±20 ppm

TRIGGER

Source:	External or Software
External Trigger Level:	TTL
Trigger Slope:	Rising
Connector:	SMA

EXTERNAL CLOCK

Clock Frequency:	Maximum 300 MHz Minimum 1 MHz
Voltage Level:	TTL
Duty Cycle:	50%
Connector:	SMA
Selection:	Software-selectable

DIGITAL OUTPUT MARKER

One synchronizing digital output is provided on the digital Output Marker SMA connector.
A 4-sample-wide TTL Marker pulse may be positioned, with a resolution of 4 samples, at any time during output waveform generation.

Connector: SMA

LINK'N'LOOP

The CompuGen 4300 supports Link'N'Loop Mode, which allows multiple pattern segments to be uploaded to the CompuGen's on-board memory for later selective generation.

In Link'N'Loop Mode, the CompuGen on-board memory is segmented and filled with waveform segments of equal length. As an example, with the CompuGen 4300, which has 1M of pattern memory per channel, up to 1024 waveform segments of 1024 points each may be pre-loaded into CompuGen memory for later generation.

All Link'N'Loop segment configuration parameters are uploaded before Link'N'Loop generation so that no software interaction is required to switch amongst segments.

MULTI-CARD SYSTEMS

Maximum No. of Cards:	4
Operating Mode:	Multiple/Independent

PCI BUS INTERFACE

Plug-&-Play:	Fully supported
Bus Width:	32 bits
Bus Speed:	33 MHz
Compatibility:	5 Volt PCI-compliant slot

ENVIRONMENTAL

Temperature:	
Operating:	0 degree Celsius to 70 degrees Celsius standard
Non-Operating:	-40 degrees Celsius to 85 degrees Celsius extended
Humidity:	
Operating:	20% to 80% (no condensation)
Non-Operating:	5% to 95% (no condensation)

APPLICATION SOFTWARE

CGTest Software

SOFTWARE DEVELOPMENT KITS (SDK)

- CompuGen PCI SDK for C/C++ for Windows
- CompuGen PCI SDK for MATLAB for Windows
- CompuGen PCI SDK for LabVIEW for Windows

WARRANTY

One year parts and labor

All specifications subject to change without notice.

CompuGen 4300 ordering information

Hardware, upgrades & options

Product	Order No.
CompuGen 4300	800-100-430

CompuGen 4300 block diagram

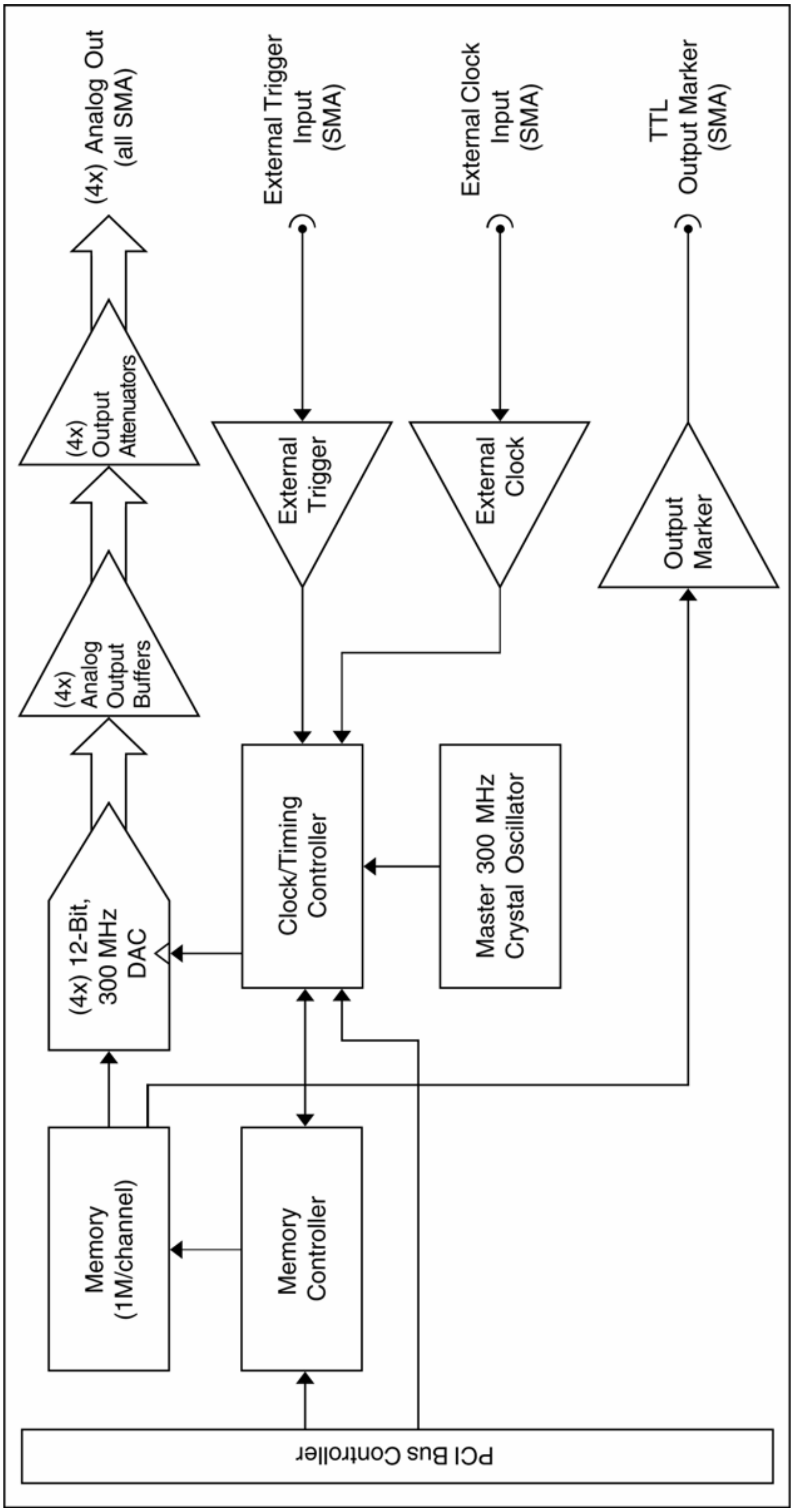


Figure 10: CompuGen 4300 block diagram

CompuGen 4300 connectors

CompuGen cards generate and receive all signals (digital and analog) on SMA connectors. The function of each SMA connector is shown below.

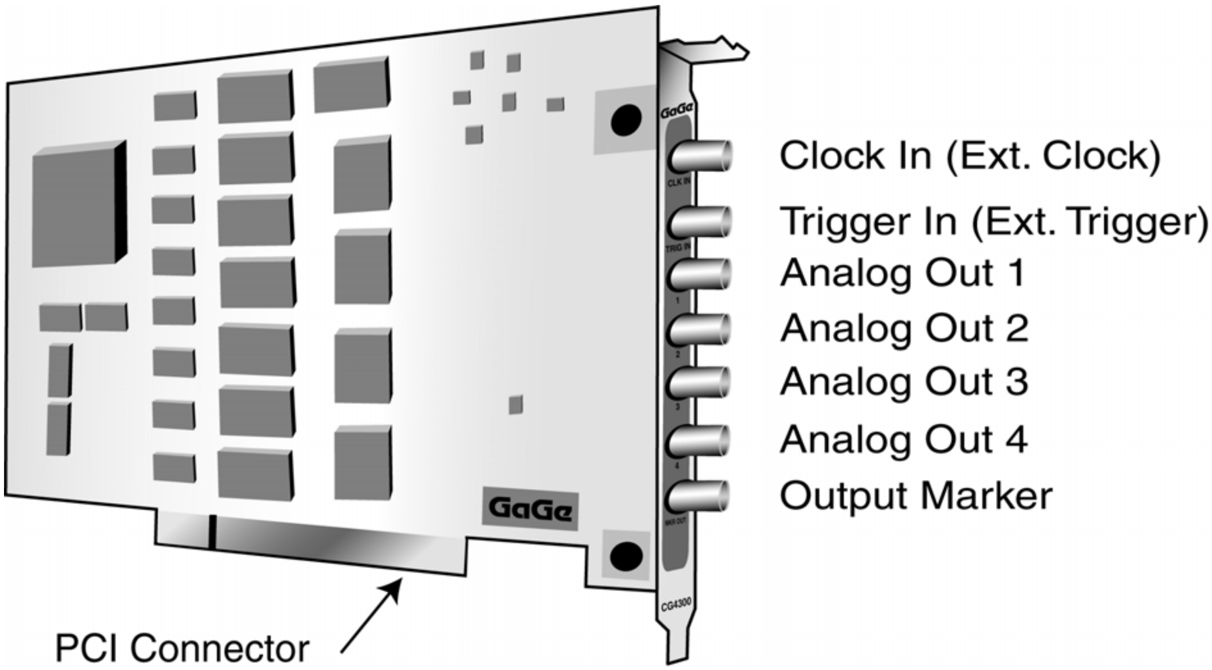


Figure 11: Connectors for the CompuGen 4300

CompuGen 4300 attenuator

The CompuGen 4300 is equipped with an on-board signal attenuator that may be used to optimally exploit the 12-bit resolution of the CG4300 by reducing the effective output range. The unattenuated output range of the CG4300, accounting for the 1.2 dB insertion loss introduced by the attenuator circuitry, is

$$+/- 1 \text{ Volt} \times 10^{-(1.2 \text{ dB})/20 \text{ dB}} \underset{\cdot}{=} \pm 0.87 \text{ Volts},$$

which is spanned by $2^{12} = 4096$ different discrete output levels. This gives a minimum output voltage step of 1.74 V/4096 = 0.43 mV. The attenuator allows the reduction of this minimum step amplitude by a factor of more than 30 dB.

The CG4300 attenuator reduces the effective output range so that the 4096 levels span a lower effective output voltage range. The attenuator setting is specified in dB and may be adjusted from CGTest or from an SDK program. The effective output range may be calculated as follows:

$$\text{Effective Output Range} \underset{\cdot}{=} \pm 0.87 \text{ Volts} \times 10^{-(\text{Attenuator Setting})/20 \text{ dB}}$$

For instance, if an attenuation value of 30 dB is selected, then the effective output range becomes:

$$\text{Effective Output Range} \underset{\cdot}{=} \pm 0.87 \text{ Volt} \times 10^{-(30 \text{ dB})/20 \text{ dB}}$$

$$= \pm 0.87 \text{ Volt} \times 10^{-1.5}$$

$$= \pm 0.87 \text{ Volt} \times 0.0316$$

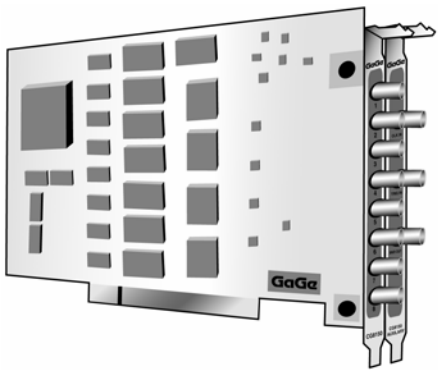
$$= \pm 27.5 \text{ mV}$$

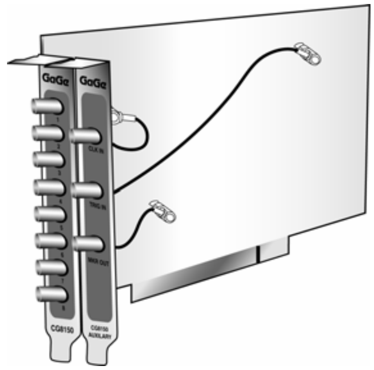
This attenuator setting reduces the minimum signal feature amplitude from 0.43 mV to
2 ×27.5 mV / 4096 = 0.013 mV. The high attenuator setting therefore allows a much smaller adjustment of the output voltage.

What you should receive with your CompuGen 8150 or CompuGen 8152

If you order a CompuGen 8150 or CompuGen 8152 card, you should receive the following articles:

- One CompuGen 8150 or CompuGen 8152 card (front and back views shown)





- Standard items included with each CompuGen 8150 or CompuGen 8152 card

GaGe CompuGen PCI Drivers, CGTest software, and CompuGen PCI SDKs

The GaGe Software Disk contains the software drivers you need to operate your CompuGen PCI hardware. It also contains the CompuGen PCI Hardware Manual and Driver Installation Guide, in PDF format.

This CD also contains the CGTest software, as well as the C/C++, LabVIEW, and MATLAB SDKs for your CompuGen PCI cards.

Warranty card

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 CompuGen card.

CompuGen 8150 and CompuGen 8152 product introduction

The CompuGen 8150 and CompuGen 8152 are 150 MHz, 8-channel, 12-bit analog to digital waveform generator cards for the PCI bus. The CG8150 and CG8152 are fully Plug'n'Play-compliant PCI cards. The main performance features are:

- 150 MHz maximum digital-to-analog conversion rate
- 12-bit DAC resolution
- CG8150: a 4 MegaSample (MS) on-board memory buffer shared equally among 8 channels (512 KS per channel)
- CG8152: a 16 MegaSample (MS) on-board memory buffer shared equally among 8 channels (2 MS per channel)
- Multi-card operation for up to 32 output channels

CompuGen 8150 and CompuGen 8152 feature description:

- **8 SIMULTANEOUS OUTPUT CHANNELS**
  The CG8150 and CG8152 are equipped with 8 high-speed 12-bit Digital-to-Analog Converter (DAC) chips. Each DAC chip is clocked by the same conversion clock signal for simultaneous generation on all 8 channels. While each of the 8 channels may generate its own distinct waveform, corresponding samples from each waveform are generated simultaneously. This simultaneous clocking of all 8 channels is crucial for the generation of phase-sensitive signals such as: the simulation of 3-phase power signals, and the simulation of In-phase and Quadrature (I&Q).

- **150 MHz CONVERSION RATE**
  The CG8150 and CG8152 use a high-quality Digital-to-Analog Converter (DAC) that operates at a maximum clock frequency of 150 MHz - a new sample is output every 6.67 nanoseconds.

  An on-board crystal oscillator ensures timebase accuracy and long-term thermal stability.

- **OUTPUT RANGE**
  The CG8150 and CG8152 provide an output of ±1 Volt into a 50 Ω load. The output stage has a high slew rate. The 12-bit vertical resolution means that up to 4096 different discrete output voltage levels may be generated.

  The CG8150 and CG8152 expect a 50 Ω load so that 50 Ω coaxial cables are correctly impedance-matched and signal reflections are eliminated. If, however, a high impedance load is used, the output voltage will double so that the ±1 Volt output range becomes a ±2 Volt output range.

- **GENERATION MODES**
  The CG8150 and CG8152 may be operated in two distinct generation modes: Free Run Mode and Triggered Mode.

  - **FREE RUN MODE**
    Free Run Mode is provided for the generation of continuous repetitive signals with the CG8150 and CG8152. In Free Run Mode, the on-board memory of the CompuGen card is seamlessly and endlessly looped during signal generation. For example, a single cycle may be uploaded to CompuGen 8150 memory and looped in order to create a continuous sine wave signal.

    In Free Run Mode, signal generation is initiated from software. For instance, from the CGTest signal generation software, generation is initiated by the click of a button. Alternatively, a user-developed program may initiate signal generation upon occurrence of some other timed event.

  - **TRIGGERED MODE**
    In Triggered Mode, the CG8150 and CG8152 are configured to generate their pre-programmed waveform in a single-shot fashion - once every time a trigger event occurs. The trigger circuitry is automatically re-armed in hardware after single-shot waveform generation in order to await another trigger event. Since it is done in hardware with no software interaction required, trigger re-arm is lightening-fast. By issuing multiple triggers, therefore, the user can easily create waveform bursts.

The source of the trigger event can be a software trigger or an external trigger signal. Using external triggering, the CompuGen card generates a single-shot waveform upon receipt of the rising edge of a TTL pulse at the external trigger input. Using software triggering, the generation of a single-shot waveform occurs when a software command is issued.

- **EXTERNAL CLOCK**
  External clocking functionality is a standard feature of the CG8150 and CG8152. External clocking allows the user to clock the DAC directly with a supplied clocking signal. This is necessary when signal generation must be synchronized with an external reference signal.

  In External Clock Mode, there is a divide-by-2 frequency divider stage between the input external clocking signal and the DAC chip. Consequently, a new sample is generated by the CompuGen card upon every second rising edge of the supplied TTL clocking signal. For example, if the user connects a 250 MHz clocking signal, the output waveform will be generated at a 125 MHz conversion rate. This direct external clocking method is preferred since alternate methods that employ Phase-Lock-Loop (PLL), or re-clocking circuitry can lead to missed or extra clock pulses.

  The external clocking signal must be a TTL signal with 50% duty cycle. The user must ensure that the external clocking frequency is between 1 MHz and 300 MHz (for a 500 kHz and 150 MHz conversion rate, respectively).

- **EXTERNAL TRIGGER**
  The CG8150 and CG8152 come equipped with an SMA external trigger input. The external trigger input is used only when the CompuGen card is operated in Triggered Mode. In Triggered Mode, the CompuGen card generates a single-shot waveform upon receipt of the rising edge of a TTL pulse at the external trigger input.

- **DIGITAL OUTPUT MARKER**
  The CG8150 and CG8152 come equipped with an SMA connector that provides a digital Output Marker signal. The Marker output produces a TTL signal with a TRUE level of 1.3 V and a FALSE level of 0 Volts, assuming 50 Ohm terminating impedance. The main usage of the Marker Output is for creating digital signals that may be used as external trigger source for other devices, such as a CompuScope digitizer card. Software control allows placement of a Marker pulse that is 4 samples wide and that occurs during pattern generation. The Marker position may be specified with a resolution of 4 samples anywhere within the CompuGen pattern. The Marker position value specifies the position of the falling edge of the Marker Pulse. For instance, consider a pattern of length 8192. A Marker position of 0 will cause the Marker output to generate a digital marker pulse at the beginning of the pattern. Similarly, a Marker position of 4096 will create an Output Marker pulse in the middle of the pattern, while a Marker position of 8180 will create a Marker pulse near the end of the pattern.

  CGTest is equipped with a digital control that is used to position (with a resolution of 4 samples) a Marker pulse at any time during output waveform generation.

  Output Marker positioning is similarly controllable from any CompuGen SDK.

- **LINK'N'LOOP**
  The CG8150 and CG8152 support Link'N'Loop Mode, which allows multiple pattern segments to be uploaded to the CompuGen's on-board memory for later selective generation. Link'N'Loop Mode is significantly more complex than normal CompuGen mode and so should be used only by users who are already comfortable with normal CompuGen operation. Link'N'Loop Mode is accessible using only the CompuGen Software Development Kits and so is comprehensively documented within the CompuGen SDK manual.

  The advantage of Link'N'Loop Mode is that waveforms need not be sequentially uploaded to the CompuGen card during a generation session. Instead, waveform segments may be preloaded onto the CG8150 or CG8152 and then the user may rapidly switch between different segments during generation. In Link'N'Loop Mode, the CompuGen on-board memory is segmented and filled with waveform segments of equal length. As an example, with the CompuGen 8150, which has 512k of pattern memory per channel, up to 512 waveform segments of 1024 points each may be pre-loaded into CompuGen memory for later generation. Similarly, the 2M memory per channel of the CompuGen 8152 may be filled with up to 2048 waveform segments of 1024 points. Different triggering and looping conditions may be pre-selected for each Link'N'Loop segment. Segment configurations are pre-loaded so that, during generation, the user may switch between different waveform segments with no software interaction required.

- **MULTI-CARD SYSTEMS**
  Up to 4 multiple/independent CG8150 and CG8152 cards can be installed if more than eight output channels are needed. PCs with up to 32 high-speed output channels can therefore be configured.

CompuGen 8150 and CompuGen 8152 specifications

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

SYSTEM REQUIREMENTS

PCI bus compatible PC with at least one free PCI slot and one adjacent slot or bracket location, 128 MB RAM, 50 MB hard disk and SVGA video. Only one free PCI slot is required if you are not using the auxiliary connector bracket.

SIZE

Single-slot mid-sized PCI card.

POWER REQUIREMENTS

+5 V	2.5 Watts*
+3.3 V	8.4 Watts*
+12 V	2.6 Watts*
-12 V	1.2 Watts*

Total = 14.65 Watts. (*using worst-case waveform on all channels)

DIGITAL TO ANALOG CONVERSION

Outputs:	8 per card
Output Range:	±1 V (2.0 Vp-p) single-ended output into 50 Ω
Output Coupling:	DC
Output Impedance:	50 Ω
Resolution:	12 bits
Accuracy:	±3% excluding offset
Analog Output Bandwidth:	Better than 100 MHz
Connector:	SMA
Generation Modes:	Free Run Mode (continuous looping) Triggered Mode (single-shot)
Conversion Rates:	150 MHz, 75 MHz, 37.5 MHz
Memory Buffer Depth:	CG8150: 4M samples total, 512K per channel CG8152: 16M samples total, 2M per channel
Record Length:	8 samples minimum 512K samples maximum for CG8150 2M samples maximum for CG8152
Record Length Increment:	8 samples
Output Frequency:	75 MHz to 150 Hz
Rise Time:	2.5 nanoseconds, typical
Fall Time:	2.5 nanoseconds, typical

CRYSTAL OSCILLATOR STABILITY

Long Term:	±20 ppm

TRIGGER

Source:	External or Software
External Trigger Level:	TTL
Trigger Slope:	Rising
Connector:	SMA

EXTERNAL CLOCK

Note: In External Clock Mode, the Digital-to-Analog conversion rate is equal to one half the frequency of the input external clocking signal.

Clock Frequency:	Maximum 300 MHz Minimum 1 MHz
Voltage Level:	TTL
Duty Cycle:	50%
Connector:	SMA
Selection:	Software-selectable

DIGITAL OUTPUT MARKER

One synchronizing digital output is provided on the digital Output Marker SMA connector.
A 4-sample-wide TTL Marker pulse may be positioned, with a resolution of 4 samples, at any time during output waveform generation.

Connector:	SMA

LINK'N'LOOP

The CompuGen 8150 and CompuGen 8152 support Link'N'Loop Mode, which allows multiple pattern segments to be uploaded to the CompuGen's on-board memory for later selective generation.

In Link'N'Loop Mode, the CompuGen on-board memory is segmented and filled with waveform segments of equal length. As an example, with the CompuGen 8150, which has 512k of pattern memory per channel, up to 512 waveform segments of 1024 points each may be pre-loaded into CompuGen memory for later generation. Similarly, the 2M memory per channel of the CompuGen 8152 may be filled with up to 2048 waveform segments of 1024 points.

All Link'N'Loop segment configuration parameters are uploaded before Link'N'Loop generation so that no software interaction is required to switch amongst segments.

MULTI-CARD SYSTEMS

Maximum No. of Cards:	8
Operating Mode:	Multiple/Independent

PCI BUS INTERFACE

Plug-&-Play:	Fully supported
Bus Width:	32 bits
Bus Speed:	33 MHz
Compatibility:	5 Volt PCI-compliant slot

ENVIRONMENTAL

Temperature:	
Operating:	0 degree Celsius to 70 degrees Celsius standard
Non-Operating:	-40 degrees Celsius to 85 degrees Celsius extended
Humidity:	
Operating:	20% to 80% (no condensation)
Non-Operating:	5% to 95% (no condensation)

APPLICATION SOFTWARE

CGTest Software

SOFTWARE DEVELOPMENT KITS (SDK)

- CompuGen PCI SDK for C/C++ for Windows
- CompuGen PCI SDK for MATLAB for Windows
- CompuGen PCI SDK for LabVIEW for Windows

WARRANTY

One year parts and labor

All specifications subject to change without notice.

CompuGen 8150 and CompuGen 8152 ordering information

Hardware, upgrades & options

Product	Order No.
CompuGen 8150	800-100-815
CompuGen 8152	800-100-816

CompuGen 8150 and CompuGen 8152 block diagram

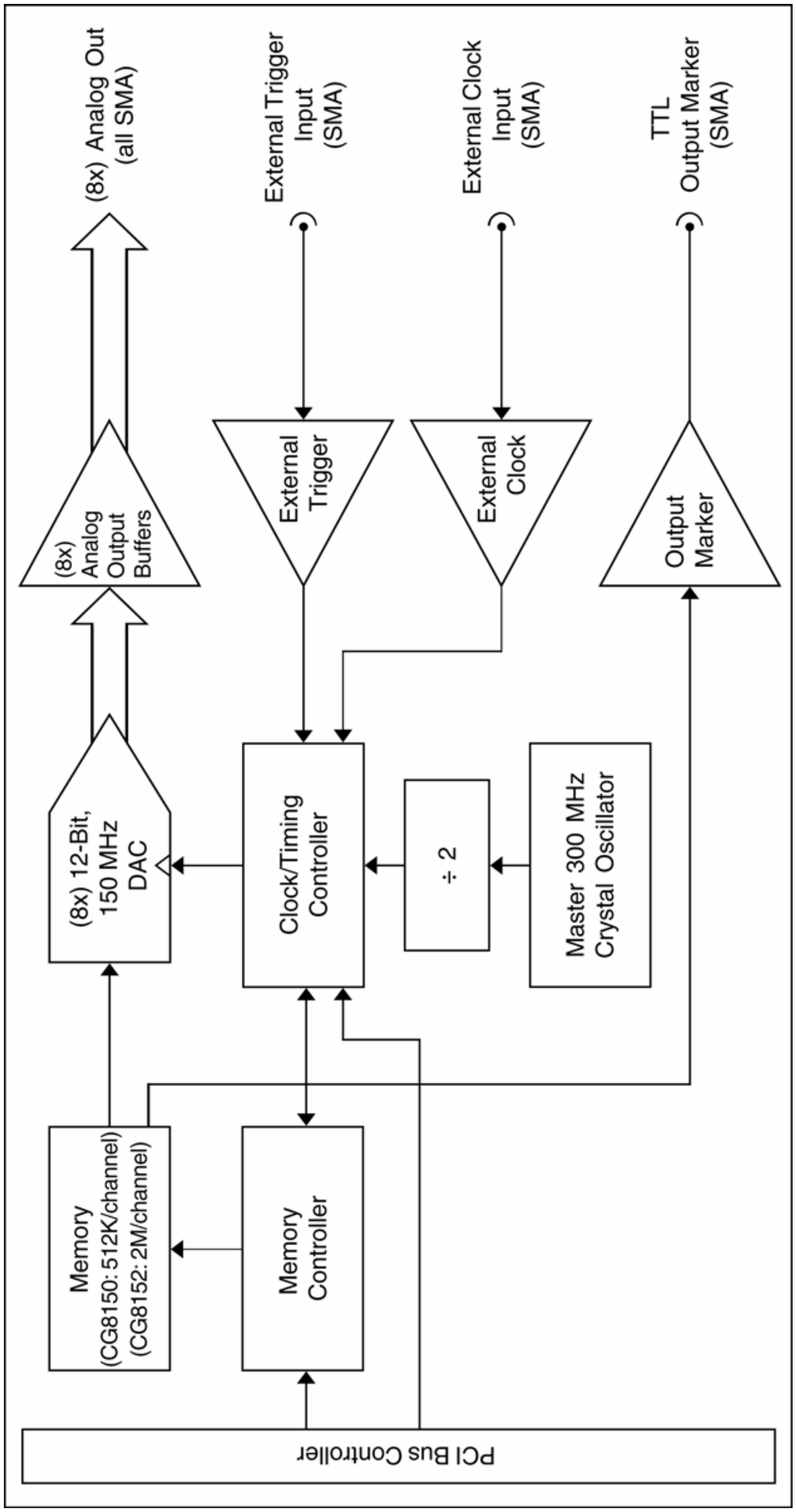


Figure 12: CompuGen 8150 and CompuGen 8152 block diagram

CompuGen 8150 and CompuGen 8152 connectors

CompuGen cards generate and receive all signals (digital and analog) on SMA connectors. The function of each SMA connector is shown below.

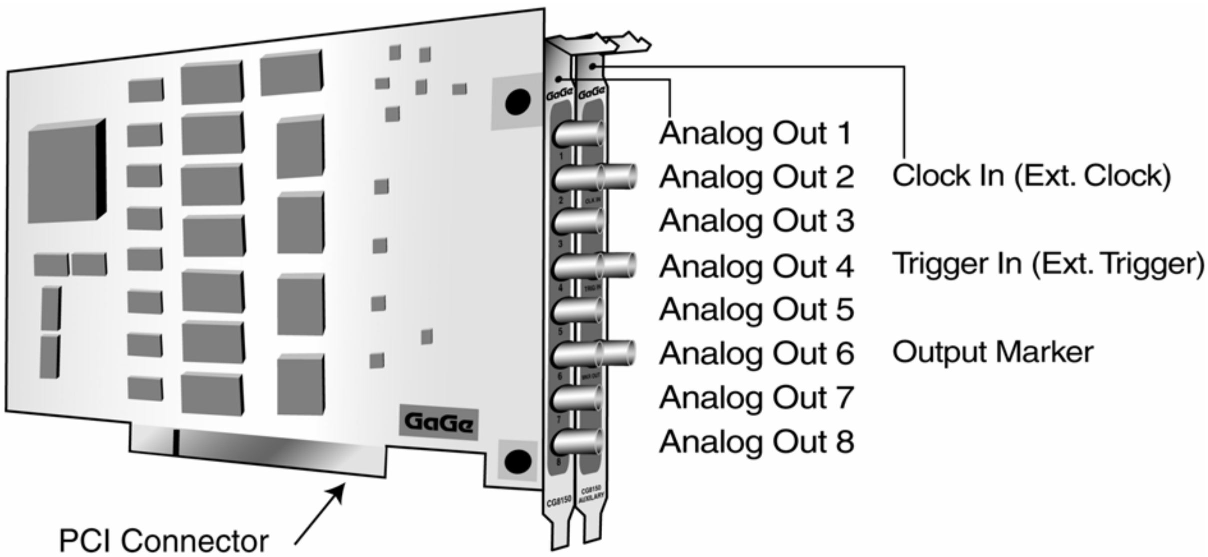
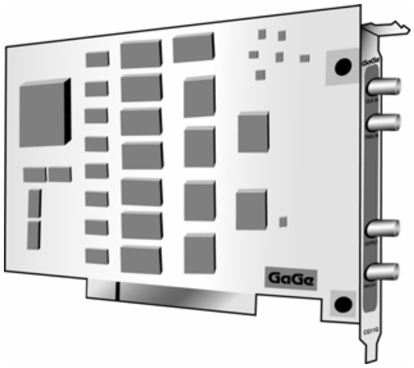


Figure 13: Connectors for the CompuGen 8150 and CompuGen 8152

What you should receive with your CompuGen 11G

If you order a CompuGen 11G card, you should receive the following articles:

- One CompuGen 11G card



- Standard items included with each CompuGen 11G card

GaGe CompuGen PCI Drivers, CGTest software, and CompuGen PCI SDKs

The GaGe Software Disk contains the software drivers you need to operate your CompuGen PCI hardware. It also contains the CompuGen PCI Hardware Manual and Driver Installation Guide, in PDF format.

This CD also contains the CGTest software, as well as the C/C++, LabVIEW, and MATLAB SDKs for your CompuGen PCI cards.

Warranty card

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 CompuGen card.

CompuGen 11G product introduction

The CompuGen 11G is a 1 GHz, 12-bit analog to digital waveform generator card for the PCI bus. The CompuGen 11G is a fully Plug'n'Play-compliant PCI card. Its main performance features are:

- 1 GHz maximum digital-to-analog conversion rate
- 12-bit DAC resolution
- A 4 MegaSample (MS) on-board memory buffer

CompuGen 11G feature description:

- **1 GHZ CONVERSION RATE**
  The CompuGen 11G uses a high-quality Digital-to-Analog Converter (DAC) that operates at a maximum clock frequency of 1 GHz - a new sample is output every 1 nanosecond.

  An on-board crystal oscillator ensures timebase accuracy and long-term thermal stability.

- **OUTPUT RANGE**
  The CompuGen 11G provides an output of ±250 mV into a 50 Ω load. The output stage has a high slew rate. The 12-bit vertical resolution means that up to 4096 different discrete output voltage levels may be generated.

  The CompuGen 11G expects a 50 Ω load so that 50 Ω coaxial cables are correctly impedance-matched and signal reflections are eliminated. If, however, a high impedance load is used, the output voltage will double so that the ±250 mV output range becomes a ±500 mV output range.

  The Output of the CompuGen 11G is AC coupled with a low frequency roll-off of 100 kHz. Consequently, components of output signals that are below this frequency will be severely attenuated.

- **GENERATION MODES**
  The CompuGen 11G may be operated in two distinct generation modes: Free Run Mode and Triggered Mode.

  - **FREE RUN MODE**
    Free Run Mode is provided for the generation of continuous repetitive signals with the CompuGen 11G. In Free Run Mode, the on-board memory of the CompuGen 11G is seamlessly and endlessly looped during signal generation. For example, a single cycle may be uploaded to CompuGen 11G memory and looped in order to create a continuous sine wave signal.

    In Free Run Mode, signal generation is initiated from software. For instance, from the CGTest signal generation software, generation is initiated by the click of a button. Alternatively, a user-developed program may initiate signal generation upon occurrence of some other timed event.

  - **TRIGGERED MODE**
    In Triggered Mode, the CompuGen 11G is configured to generate its pre-programmed waveform in a single-shot fashion - once every time a trigger event occurs. The trigger circuitry is automatically re-armed in hardware after single-shot waveform generation in order to await another trigger event. Since it is done in hardware with no software interaction required, trigger re-arm is lightening-fast. By issuing multiple triggers, therefore, the user can easily create waveform bursts.

    The source of the trigger event can be a software trigger or an external trigger signal. Using external triggering, the CompuGen 11G generates a single-shot waveform upon receipt of the rising edge of a TTL pulse at the external trigger input. Using software triggering, the generation of a single-shot waveform occurs when a software command is issued.

- **EXTERNAL CLOCK**
  External clocking functionality is a standard feature of the CompuGen 11G. External clocking allows the user to clock the DAC directly with a supplied clocking signal. This is necessary when signal generation must be synchronized with an external reference signal.

  In External Clock Mode, a new sample is generated by the CompuGen 11G upon every rising edge of the supplied TTL clocking signal. This direct external clocking method is preferred since alternate methods that employ Phase-Lock-Loop (PLL), or re-clocking circuitry can lead to missed or extra clock pulses.

  The external clocking signal must be a TTL signal with 50% duty cycle. The user must ensure that the external clocking frequency is set to one of the following fixed frequencies: 1 GHz, 500 MHz, 250 MHz, or 125 MHz.

- **EXTERNAL TRIGGER**
  The CompuGen 11G comes equipped with an SMA external trigger input. The external trigger input is used only when the CompuGen card is operated in Triggered Mode. In Triggered Mode, the CompuGen card generates a single-shot waveform upon receipt of the rising edge of a TTL pulse at the external trigger input.

- **DIGITAL OUTPUT MARKER**
  The CompuGen 11G comes equipped with an SMA connector that provides a digital Output Marker signal. The Marker output produces a TTL signal with a TRUE level of 1.3 V and a FALSE level of 0 Volts, assuming 50 Ohm terminating impedance. The main usage of the Marker Output is for creating digital signals that may be used as external trigger source for other devices, such as a CompuScope digitizer card. Software control allows placement of a Marker pulse that is 16 samples wide and that occurs during pattern generation. The Marker position may be specified with a resolution of 16 samples anywhere within the CompuGen pattern. The Marker position value specifies the position of the falling edge of the Marker Pulse. For instance, consider a pattern of length 8192. A Marker position of 0 will cause the Marker output to generate a digital Marker pulse at the beginning of the pattern. Similarly, a Marker position of 4096 will create an Output Marker pulse at the exact middle of the pattern, while a Marker position of 8180 will create a Marker pulse near the end of the pattern.

  CGTest is equipped with a digital control that is used to position (with a resolution of 16 samples) a Marker pulse at any time during output waveform generation.

  Output Marker positioning is similarly controllable from any CompuGen SDK.

- **LINK’N’LOOP**
  The CompuGen 11G supports Link’N’Loop Mode, which allows multiple pattern segments to be uploaded to the CompuGen’s on-board memory for later selective generation. Link’N’Loop Mode is significantly more complex than normal CompuGen mode and so should be used only by users who are already comfortable with normal CompuGen operation. Link’N’Loop Mode is accessible using only the CompuGen Software Development Kits and so is comprehensively documented within the CompuGen SDK manual.

  The advantage of Link’N’Loop Mode is that waveforms need not be sequentially uploaded to the CompuGen card during a generation session. Instead, waveform segments may be preloaded onto the CompuGen 11G and then the user may rapidly switch between different segments during generation. In Link’N’Loop Mode, the CompuGen on-board memory is segmented and filled with waveform segments of equal length. As an example, with the CompuGen 11G, which has 4M of pattern memory per channel, up to 4096 waveform segments of 1024 points each may be pre-loaded into CompuGen memory for later generation. Different triggering and looping conditions may be pre-selected for each Link’N’Loop segment. Segment configurations are pre-loaded so that, during generation, the user may switch between different waveform segments with no software interaction required.

- **MULTI-CARD SYSTEMS**
  Up to 8 multiple/independent CompuGen 11G cards can be installed if more than one output channel is needed. PCs with up to 8 ultra-high-speed output channels can therefore be configured.

CompuGen 11G specifications

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

SYSTEM REQUIREMENTS

PCI bus compatible PC with at least one free PCI slot, 128 MB RAM, 50 MB hard disk and SVGA video.

SIZE

Single-slot mid-sized PCI card.

POWER REQUIREMENTS

+5 V	2.5 Watts
+3.3 V	8.4 Watts
+12 V	2.6 Watts
-12 V	1.2 Watts

DIGITAL TO ANALOG CONVERSION

Outputs:	1 per card
Output Range:	±250 mV (0.5 Vp-p) single-ended output into 50 Ω
Output Coupling:	AC
Lower Output Cut-off Frequency:	100 kHz
Output Impedance:	50 Ω
Resolution:	12 bits
Accuracy:	±3% excluding offset
Analog Output Bandwidth:	300 MHz
Connector:	SMA
Generation Modes:	Free Run Mode (continuous looping) Triggered Mode (single-shot)
Conversion Rate:	1 GHz
Memory Buffer Depth:	4M samples total
Record Length:	64 samples minimum 4M samples maximum
Record Length Increment:	64 samples
Output Frequency:	500 MHz to 250 Hz
Rise Time:	300 picoseconds, typical
Fall Time:	300 picoseconds, typical

CRYSTAL OSCILLATOR STABILITY

Long Term:	100 ppm

TRIGGER

Source:	External or Software
External Trigger Level:	TTL
Trigger Slope:	Rising
Connector:	SMA

EXTERNAL REFERENCE

The External Reference timebase is used to synchronize the internal sampling clock

Clock Frequency:	10 MHz
Voltage Level:	Sinewave 0 dBm to 10 dBm (±0.155 V to ±0.5 V)
Connector:	SMA
Selection:	Jumper-selectable
Termination:	50 Ω

EXTERNAL CLOCK

Clock Frequency:	1.0 GHz, 500 MHz, 250 MHz, 125 MHz only
Voltage Level:	Sinewave 0 dBm to 6 dBm (±0.155 V to ±0.310 V)
Connector:	SMA
Selection:	Jumper-selectable
Termination:	50 Ω

DIGITAL OUTPUT MARKER

One synchronizing digital output is provided on the digital Output Marker SMA connector.
A 16-sample-wide TTL Marker pulse may be positioned, with a resolution of 16 samples, at any time during output waveform generation.

Connector:	SMA

LINK'N'LOOP

The CompuGen 11G supports Link'N'Loop Mode, which allows multiple pattern segments to be uploaded to the CompuGen's on-board memory for later selective generation.

In Link'N'Loop Mode, the CompuGen on-board memory is segmented and filled with waveform segments of equal length. As an example, with the CompuGen 11G, which has 4M of pattern memory per channel, up to 4096 waveform segments of 1024 points each may be pre-loaded into CompuGen memory for later generation.

All Link'N'Loop segment configuration parameters are uploaded before Link'N'Loop generation so that no software interaction is required to switch amongst segments.

PCI BUS INTERFACE

Plug-&-Play:	Fully supported
Bus Width:	32 bits
Bus Speed:	33 MHz
Compatibility:	5 Volt PCI-compliant slot

ENVIRONMENTAL

Temperature:	
Operating:	0 degree Celsius to 70 degrees Celsius standard
Non-Operating:	-40 degrees Celsius to 85 degrees Celsius extended
Humidity:	
Operating:	20% to 80% (no condensation)
Non-Operating:	5% to 95% (no condensation)

APPLICATION SOFTWARE

CGTest Software

SOFTWARE DEVELOPMENT KITS (SDK)

- CompuGen PCI SDK for C/C++ for Windows
- CompuGen PCI SDK for MATLAB for Windows
- CompuGen PCI SDK for LabVIEW for Windows

WARRANTY

One year parts and labor

All specifications subject to change without notice.

CompuGen 11G ordering information

Hardware, upgrades & options

Product	Order No.
CompuGen 11G	800-100-110

CompuGen 11G block diagram

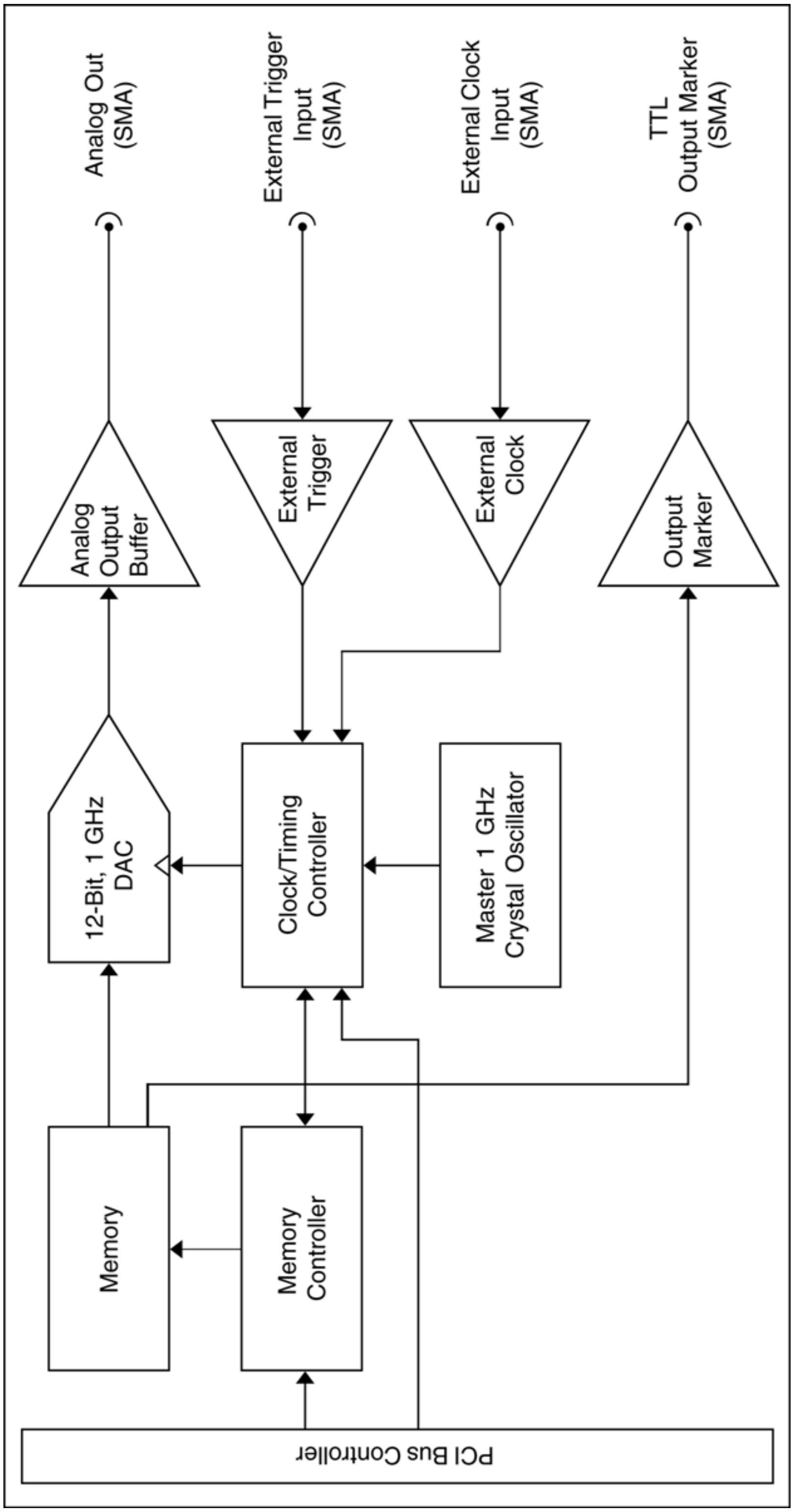


Figure 14: CompuGen 11G block diagram

CompuGen 11G connectors

CompuGen cards generate and receive all signals (digital and analog) on SMA connectors. The function of each SMA connector is shown below.

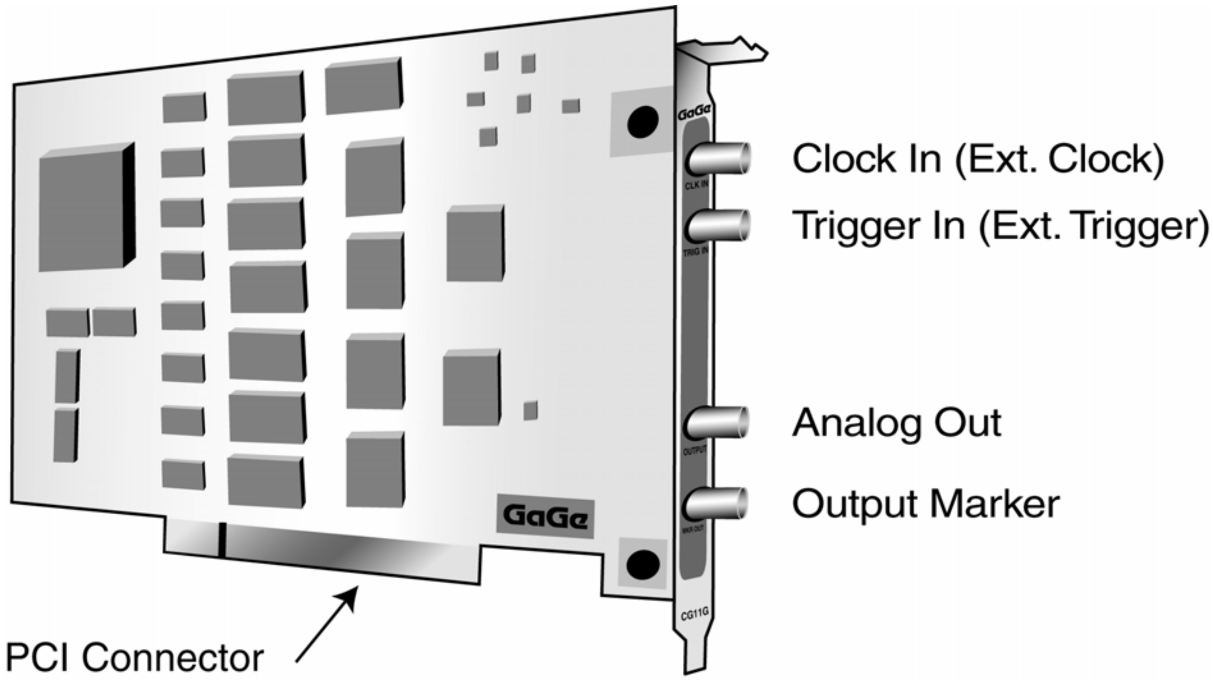


Figure 15: Connectors for the CompuGen 11G

CompuGen 11G external clock jumper configurations

JP2 (pinout)

1	2	**JUMPER 1**
3	4	**JUMPER 2**
5	6	**JUMPER 3**
7	8	**JUMPER 4**

Clock configuration table

	Jumper #1	Jumper #2	Jumper #3	Jumper #4
Use 1.0 GHz internal clock locked to 10 MHz reference	Short	Open	Open	Short
Use external clock at D/A clock rate. **Allowable rates: 1.0 GHz, 500 MHz, 250 MHz**	Open	Short	Open	Short
Lock to external 10 MHz reference. **The CG11G phase locks the internal 1.0 GHz master clock to external 10 MHz reference.**	Short	Open	Short	Open

External clock input notes

High-speed clock input	D/A rate	50 Ohm SMA input. Sinewave from 0 dBm to 6 dBm (±0.155 V to ±0.310 V) Can only use the following frequencies: 1.0 GHz, 500 MHz, 250 MHz, and 125 MHz.
Low-speed clock input	10 MHz reference only	50 Ohm SMA input. Sine/square wave from 0 dBm to 10 dBm (±0.155 V to ±0.5 V)

Technical Support

We offer technical support for all our products.

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

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

To obtain technical support, simply visit:

www.gage-applied.com/support/support_form.php

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

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

tech-support@gage-applied.com

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

Please note that Technical Support Requests received

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

It is faster to use the web site!

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

1. Version and type of your CompuGen SDK and drivers.
   (Version numbers can be obtained by looking in the appropriate README.TXT files that are installed with the drivers and SDKs)

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

3. Type and version of your operating system.

4. Type and speed of your computer and bus.

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

6. Were you able to reproduce the problem with standalone GaGe Software (i.e. CGTest)?

GaGe products

For ordering information, see the GaGe 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 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
	Octopus multi-channel digitizer family	Up to 8 channels on a single-slot PCI card, 12 or 14-bit resolution, 10 to 125 MS/s
	CompuScope 12400	12 bit, 400 MS/s A/D card
	CompuScope 12100	12 bit, 100 MS/s A/D card
	CompuScope 1220	12 bit, 20 MS/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 PCI	CompuGen 4300	12 bit, 4-channel, 300 MHz Analog Output Card
	CompuGen 8150 CompuGen 8152	12 bit, 8-channel, 150 MHz Analog Output Cards
	CompuGen 11G	12 bit, 1 GHz Analog Output Card
CompuGen ISA	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	CompuScope SDK for C/C#	CompuGen SDK for C/C++
	CompuScope SDK for MATLAB	CompuGen SDK for LabVIEW
	CompuScope SDK for LabVIEW	CompuGen SDK for MATLAB
Instrument Mainframes	Instrument Mainframe 7500 Instrument Mainframe 2000	Instrument Mainframes for Housing CompuScope PCI bus and CompuGen ISA bus Products
	Instrument Mainframe 8000C	Instrument Mainframes for Housing CompuScope CompactPCI/PXI bus products