GaGe

CompuGen for Windows
Startup Guide

for the CompuGen 1100

CompuGen for Windows Startup Guide

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Toll-free phone: (800) 567-4243   *Outside North America:* Tel: (514) 633-7447
Toll-free fax: (800) 780-8411   Fax: (514) 633-0770

Email: prodinfo@gage-applied.com
Website: http://www.gage-applied.com

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CompuGen for Windows version:	_____
Owned by:	_____
Serial Number:	_____
Purchase Date:	_____
Purchased From:	_____

You must also have the following information when you call:

- Brand name and type of computer
- Processor and bus speed
- Total memory size
- Contents of AUTOEXEC.BAT and CONFIG.SYS files
- Information on all other hardware in the computer

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Contents

Preface

This manual provides detailed information on the features of CompuGen for Windows software, including equation entry of waveforms. It also takes you through the process of installing CompuGen for Windows and describes available custom features. Finally, it provides information on Gage's CompuGen family of signal generation cards.

Please note that this manual is not intended as a reference for any software other than CompuGen for Windows version 2.0. If you did not receive the correct guide, please contact the factory for a replacement.

To maintain the accuracy of the information contained herein, we reserve the right to make changes to this manual without notice.

Note: For brevity, "CGWIN" is occasionally used to refer to CompuGen for Windows software.

Introduction and Specifications

CompuGen for Windows is a Windows-based software package for controlling CompuGen Arbitrary Waveform Generator Boards.

Creating the complex waveforms needed for testing in today's industrial and research environments demands a method that is fast, efficient, and highly precise. Math equation entry emerges as the unqualified winner for generating and altering waveforms of virtually any complexity, where other waveform generation methods—point-by-point, thumbtack-rubberband, piecewise linear, tablet draw, scope draw, multiple analog generators, etc.—are cumbersome and imprecise.

The power of math entry is evident by the ease with which you can create "chirps," AM, FM, sweeps, read/write signals, video, sine x/x, integrated signals, logarithms, exponentials, and other complex functions as well as sine, square, triangle, and ramp. Being able to use math equations to construct waveshapes allows the user to simulate real world signals easily and inexpensively. Arbitrary waveform generators with math entry are the only true analog emulators.

The CompuGen Family

CompuGen cards are PC-based arbitrary waveform generator and digital pattern generator cards. The cards are equipped with on-board memory for storing the digital pattern, which is then output at high speed. In the case of analog output, the digital pattern is fed into a D/A converter and the output is made available at the BNC connector after amplification and filtering.

Multiple CompuGens

CompuGen for Windows supports multiple CompuGen boards in the same system. These boards must be in a Master/Slave configuration with common clock and trigger. CGWin can output signals from all the boards simultaneously, i.e., with the same D/A clock.

Predefined Signals

The user can operate CompuGen for Windows to output standard waveforms such as sine, triangular and square waves, ramp, and DC level. In the case of multiple CompuGen boards, CGWin also allows the user to control the phase angle between different outputs.

Arbitrary Waveforms

CompuGen for Windows lets the user create arbitrary waveforms through the entering of equations or by the familiar "cuting and pasting" of existing files. These waveforms can then be output through a CompuGen board.

Equation Entry: The user can enter mathematical equations to create a waveform. CompuGen for Windows allows equation entry in the form $F = f(t)$, where F is the function and $f(t)$ is the mathematical expression. A number of such expressions can be combined to create almost any waveform. Standard equations are provided for generating sweeps, chirps etc.

Cut and Paste: Two cursors allow the user to select portions of a signal, which may then be edited and concatenated to form new signals. An Edit window provides the means to edit the signals digitally.

Signal Files

CompuGen for Windows supports the GageScope file format. As such, it is possible to capture signals using a CompuScope and then replay the signal using a CompuGen. Signals can be saved to disk and read back as MS-DOS files.

Modes of Operation

CompuGen for Windows can operate the CompuGen cards in either One-Shot or Repetitive mode. In repetitive mode, a pattern can be generated continously or a certain number of times.

Trigger Control

CompuGen for Windows allows the user to take advantage of the flexible triggering capabilities of the CompuGen cards. Both internal and external triggering are supported.

CompuGen for Windows Specifications

SYSTEM REQUIREMENTS

Pentium-based IBM PC compatible computer. VGA Graphics card and monitor. 2 MB of available hard disk space. Windows 95 with 16 Mb of RAM or Windows NT with 32 Mb of RAM. A CompuGen card must be present in the system to output data, otherwise CompuGen for Windows operates in DEMO mode.

HARDWARE SETUP

Channels:	1 per CompuGen card. The first channel is always the Master channel and the rest, if present, are Slave channels
Sample Rate:	Dependent on CompuGen hardware
Output Range:	Dependent on CompuGen hardware
Memory Depth:	Dependent on CompuGen hardware

TRIGGERING

Source:	External or Internal
Slope:	Positive or Negative

DISPLAY

Timebase:	1 ns/div to 1 Ms/div
Vertical Scale:	5 mV/div to 1 kV/div

FILE SAVING

File Format:	GageScope binary format
Setups:	Binary file
Equations:	CompuGen for Windows standard file format

EQUATION ENTRY

Number of Equations per Signal Description:	8

MATERIALS SUPPLIED

CompuGen for Windows Software Manual
CompuGen for Windows installation disks (3.5" floppy disks)

WARRANTY

One year warranty on the media which contain the CompuGen for Windows program

All specifications subject to change without notice

Supported Hardware

CompuGen 1100

SYSTEM REQUIREMENT

IBM PC AT or ISA bus compatible PC with 4MB of RAM, VGA Graphics card and monitor, and 2 MB free space on the hard drive.

SIZE

Single-slot full-length IBM PC/XT

POWER

15 Watts at +5 Volts
9 Watts at +12 Volts
1 Watt at -12 Volts
0.5 Watts at -5 Volts

FEATURES

Pattern Output - Single Shot
  Record Length: 4 points min
  Record Resolution: 2 points

Trigger Modes: Single, timed, or retriggerable

DIGITAL TO ANALOG CONVERSION

Outputs: 1 per card
Amplitude: 20 V p-p into 1 KΩ
                      10 V p-p into 50 Ω
Resolution: 12 bits
Accuracy: $\pm$ 2% excluding offset
Clock Frequency: Min 1 Hz, Max 80 MHz
Conversion Rates: 80 MHz, 40 MHz, 20 MHz
Output Frequency: 10 MHz to 61 uHz
Buffer Depth: 512K, 1M, 2M, 4M, 8M and 16Msamples
Full Scale Output
  Voltage Range: $\pm$100V, $\pm$200V, and $\pm$500V
                      $\pm$1V, $\pm$2V, and $\pm$5V
        These voltages are specified with 50Ω termination.
           With no termination, voltage is doubled.
Output Impedance: 50 Ω
Filter: 10 MHz fixed filter
Output Protection: Short protected up to $\pm$50 Volts
Connector: BNC

FREQUENCY STABILITY

Long Term: 25 ppm

TRIGGER

Source: Internal or External
External Trigger: TTL
Trigger Slope: Rising or Falling
Connector: BNC

EXTERNAL CLOCK

Clock Frequency: Min DC, Max 80 MHz
Voltage: TTL, CMOS, or ECL
Connector: BNC
Selection: Software selectable

SOFTWARE AVAILABLE

WINDOWS 95/98/NT
- CompuGen Analog SDK for Windows (Visual C++ Source Code Sample Programs included)
- CompuGen Analog SDK for MATLAB for Windows
- CompuGen Analog SDK for LabView for Windows

MATERIALS SUPPLIED

One CompuGen 1100 card
One CompuGen for Windows software disk
BNC Cable
Reference Manual

RECOMMENDED ACCESSORIES

50 Ω Shunt

WARRANTY

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

Installing CompuGen for Windows

It is recommended that you exit open programs before installing CompuGen for Windows.

1. Place the Install Disk into your computer's floppy drive.

2. Click on the START button at the bottom left of the Windows display. The Start menu appears.

3. Click on RUN.

4. Type in `a:\setup.exe` and press ENTER. You will see a message stating that CompuGen for Windows Setup is preparing the InstallShield Wizard.
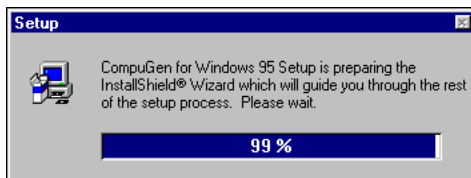
5. When complete, you will see the Welcome dialog. Click NEXT to advance to the next screen.

6. You will be prompted to select the folder in which you wish to install the software.

If you wish to change the destination folder, click on BROWSE and then choose an existing folder or enter the name of a new folder.

If you type in the pathname of a folder which does not exist, you will be asked if you would like to create the directory at this time. Select YES to create a new directory, or NO to go back.

7. When you have chosen a folder, click NEXT.

8. Next you are asked to choose a Program Folder for listing CompuGen for Windows within the Start menu. You can use the default, enter a new folder name, or choose from existing Program Folders.
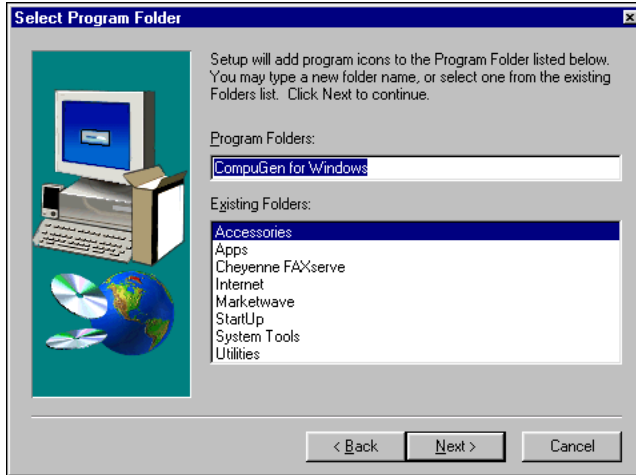
9. When you have chosen a Program Folder, click NEXT, and the installation will begin.

10. When installation is complete, click on FINISH.

NOTE

The CompuGen for Windows executable file is named **CGWIN95**.

Using CompuGen for Windows

Starting and Exiting

To run CompuGen for Windows, select CompuGen for Windows from the Start menu. You can also run the CGWIN95 program directly from the folder you chose when you installed the program.

When CompuGen for Windows starts, you will see the following window:
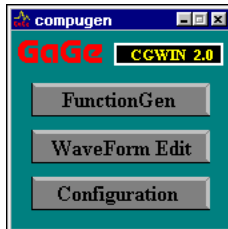
Version Information

The version of CompuGen for Windows you are using is listed at the top right of the startup window. Clicking in this area brings up the About CompuGen for Windows dialog, which lists the current version as and date of manufacture, as well as the phone numbers and web site address for Gage Applied Technologies, Inc..
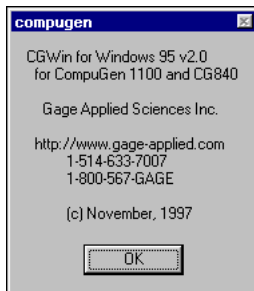
Click OK to clear this dialog.

About the CompuGen for Windows Options

- Click on **FunctionGen** to launch the the Function Generator, which allows you to create signals similar to having a stand-alone generator.

- Click **Waveform Edit** to launch the Waveform Editor, which allows you to load and edit pre-existing waveforms. The Waveform Editor also lets you create waveforms via equation entry.

- Click on **Configuration** to set up CompuGen for Windows to work with your CompuGen card.

Detailed instructions for using FunctionGen, Waveform Edit, and Configuration appear later in this manual.

First Time Using CompuGen for Windows?

If this is your first time using CompuGen for Windows, it is recommended that you click on **Configuration** first in order to set up the software to work with your CompuGen board. See the

instructions on the following pages for details.

Error Message

If your board is not set up properly, or if you click on FunctionGen or Waveform Edit before using the Configuration option, you may see the following message:

This message indicates either that you have not installed a CompuGen card, or that your hardware settings are incorrect.
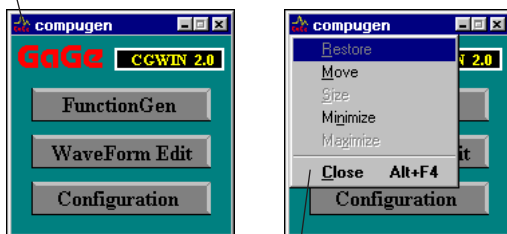
Use the **Configuration** button to see if your CompuGen board's settings are correct. Also check the documentation accompanying your CompuGen board for more information on your particular CompuGen board.

If this error occurs, CompuGen for Windows will run in demo mode. Some features will not be available.

Exiting the Program

Click on the Control menu at the top left corner of the window, and choose Close.

You can also press ALT-F4.

Configuration of the CompuGen 1100 for use in CompuGen for Windows

When configuring your CompuGen 1100 card, keep in mind that you must have both an I/O address space and a memory address space available. Note: By convention, segment addresses are defined as four hex digits (16 bits) and physical addresses are five hex digits (20 bits).

About Configuring CompuGen for Windows to Work with the CompuGen 1100

To configure CompuGen for Windows to work with the CompuGen 1100, you must:

1. Set the I/O Address on the card via the I/O DIP switch as described in the hardware manual. (Refer to your manual for details.)

2. Set the I/O Address for the corresponding card in the Configuration utility in CompuGen for Windows, as described in the following pages.

3. Set the Memory Space in the Configuration utility in CompuGen for Windows, as described in the following pages.

About the I/O Address

The CompuGen 1100 requires four consecutive I/O addresses for use. For example, if the base address is 0300H for I/O, then 0300, 0301, 0302, and 0303 will be occupied by the CompuGen card.

The default set at the factory is 0300 (switches 7 and 8 ENABLED).

About Selecting Memory Space

The CG1100 requires 4K of consecutive Memory Addresses for use. This memory lies in the upper memory block between 640K and 1M. For example, if the base memory address is D200, then physical addresses D200H to D2FFF will be occupied by the CompuGen card.

These settings are specified in software using the Configuration Utility, as described on the following page. No hardware setting is required.

Memory Conflict?

EMM386 is almost always present in config.sys when running the Win 3.x environment. This causes a problem when trying to find free memory space for the CompuGen card (or any other card which requires memory space). There are two ways to free up memory space:

1. Edit your config.sys file and enter the X= parameter for the required space on the EMM386 line. You must reboot your system for the changes to take effect.

2. (Recommended.) Edit the SYSTEM.INI file in your Windows directory; you can do this from within Windows. You must look for the section called [enh386] and add the line:

   emmexclude=D200-D2FF

   D200 refers to the segment address. Save this file and exit/restart Windows.

Using the Configuration Utility

To configure CompuGen for Windows, run CompuGen for Windows and click on Configuration. A message will appear stating the name of the configuration file CompuGen for Windows is using:

Testing the Board

To find out if your card has been identified, click the TEST MASTER button. If all is in working order, you will receive the message "Memory Test Passed!" with the amount of memory your board has, as shown below.
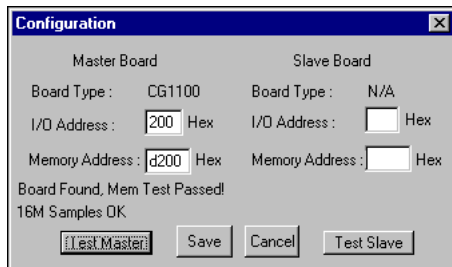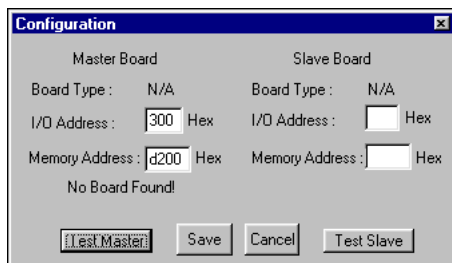

The TEST SLAVE button is for testing Master/Slave configurations.

Saving the Configuration

If you use other values instead of the default settings, clicking on SAVE will save these settings to the configuration file.

No Board Found?

If you see a "No Board Found" message, you may have either an I/O conflict or a memory conflict.

If Problems Occur

If you do not get the "Memory Test passed" message, try the following:

1. Check for a memory conflict as described in the previous pages.

2. Check the I/O switch settings as describe in your hardware manual.

3. Check for a conflict with another card in your system.

4. Enter different memory segment addresses into the "Memory Address" box and click on the TEST MASTER button to try again. Some common addresses are listed below:

D000	D100	D200	D300	D400	D500	D600	D700
D800	D900	DA00	DB00	DC00	DD00	DE00	DF00
B000	B100	B200	B300	B400	B500	B600	B700
B800	B900	BA00	BB00	BC00	BD00	BE00	BF00
C000	C100	C200	C300	C400	C500	C600	C700
C800	C900	CA00	CB00	CC00	CD00	CE00	CF00
E000	E100	E200	E300	E400	E500	E600	E700
E800	E900	EA00	EB00	EC00	ED00	EE00	EF00

Note that 64 bit video cards such as the Diamond Stealth 64 may use addresses A000 through C7FF. Consequently these addresses will not be available for the CompuGen card.

5. If problems persist, contact Gage for assistance.

Important Note Concerning CompuScope 225 and CompuScope Lite Cards:

If you are using a CompuScope 225 or CompuScope LITE (both 8 bit ISA bus cards), you will encounter a conflict if the segment is decoded in the same 128K address block as the CompuGen 1100 (16 bit AT bus card). This is an ISA bus issue. Any time the bus hardware "sees" a 16 bit card, the entire 128K address block is decoded as 16 bit, even if it is an 8 bit card. As all data accessed is decoded as a 16 bit in this situation, the data from the 8 bit card will be decoded incorrectly by the system hardware.

Memory segments are grouped by the system in the following manner:
- 128K address block A000-BFFF
- 128K address block C000-DFFF
- 128K address block E000-FFFF

The Function Generator Window
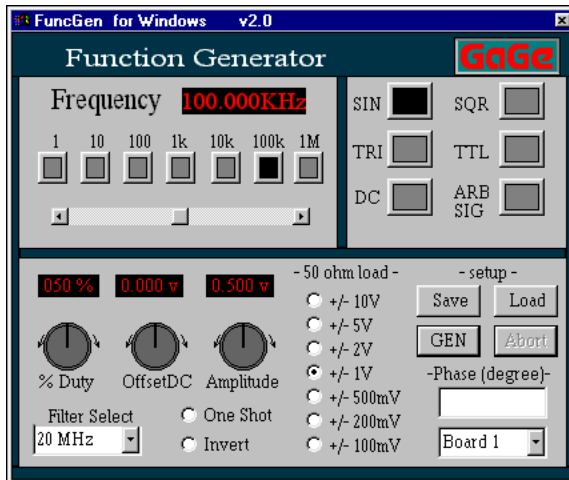
Save Setup / Load Setup

Saves or loads the current setup.

Generate ON/ Generate OFF

Toggles between allowing and disallowing signal output to the CompuGen card.

Frequency

These seven buttons allow you to set the Output Frequency to one of the following values: 1 Hz, 10 Hz, 100 Hz, 1 KHz, 10 KHz, 100 KHz, 1 MHz. Or, you can select an exact frequency with the scroll bar.

Wave Type

Select from SIN (sine wave), SQR (square wave), TRI (triangle wave), TTL, DC, or ARB SIG (Arbitrary Signal). Selecting ARB SIG brings up a window allowing the selection of a signal from previously saved signal files. When you select a particular signal file, its file name appears beneath the ARB SIG button.

Note that equations you create and save using the Waveform Editor can be used by the   Function Generator.

Voltage Range

The Voltage Range can be set to ±100mV, ±200mV, ±500V, ±1V, ±2 V, ±5 V, or ±10 V.

% Duty, OffsetDC, Amplitude

To adjust these knobs, click on the clockwise and counterclockwise arrows. To make it go faster, hold the button down when the mouse pointer is over the arrows. You can also click somewhere in front of the knob marker to quickly jump to that setting.

The **% Duty** range is from 0 to 100%. The **Offset DC** range is from -1V to +1V, and the **Amplitude** range is from 0 to 1V.
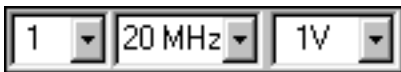
The WaveForm Editor Window
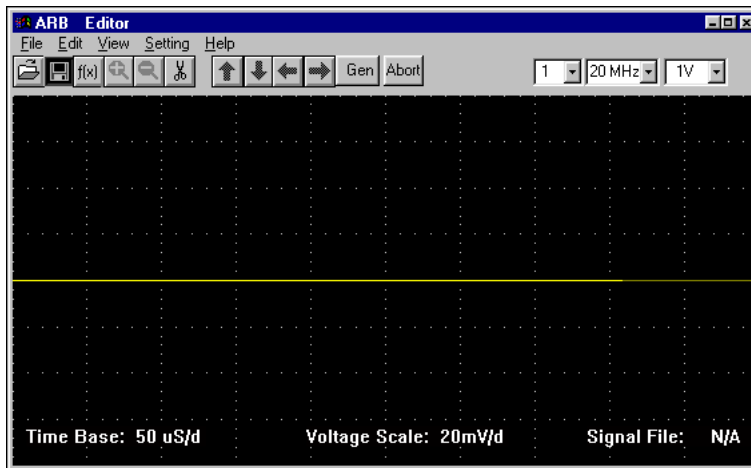
The **Time Base**, **Voltage Scale** and the name of the current **Signal File** are displayed at the bottom of the screen. If the current display is not a signal file, this field will read N/A.

The **GEN** button causes your CompuGen card to output the current signal or equation file.

The Generator Output Information is located at the top right of the window:

The first value is the **board number** (e.g., CompuGen 1100, Board 1).

The second value is the **output sampling rate** (the output frequency of the signal generator), in Hertz.

The last value is the **output voltage range** of the signal generator, in Volts.

Editing an Arbitrary Pattern

The following example will show you how to edit a selection of a loaded file. The .SIG file you will load is one that was installed along with CompuGen for Windows.

If you have an oscilloscope to use for verifying the results, connect the "signal out" of the CompuGen to your oscilloscope, then connect the Sync Out of the CompuGen to the external trigger of your oscilloscope. Set your oscilloscope to external trigger.

From the FILE menu, select Open > Signal File. In your CompuGen for Windows folder, choose DIM_SINE.SIG.

To open a file you can also click on the Open button in the Toolbar:

When the DIM_SINE file is opened, a diminishing sine wave pattern is displayed in the Arb window. You may want to adjust the size of the window in order to see more of the pattern. To do this, move the mouse pointer to the right corner of the Window and drag the mouse.
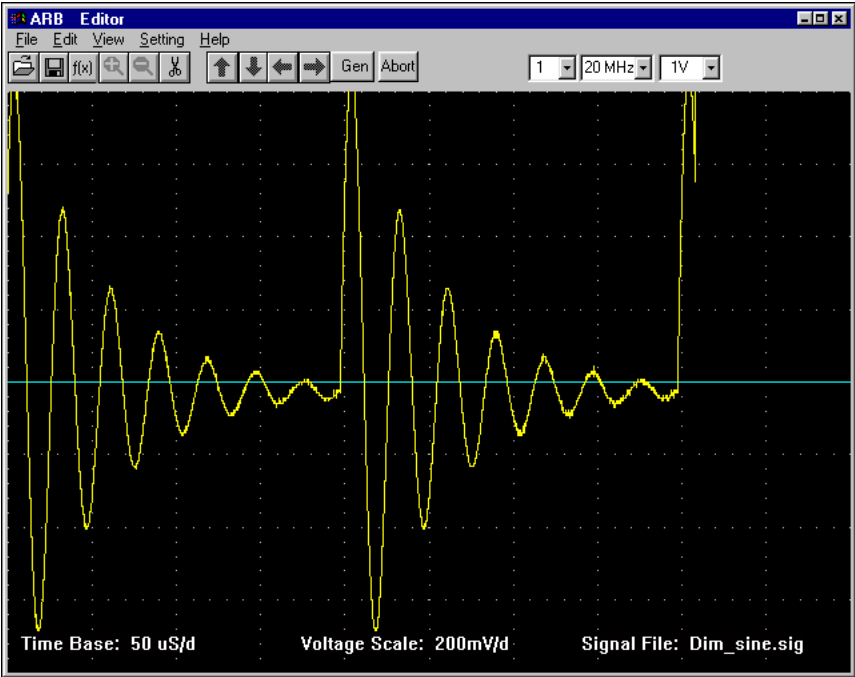
Changing the Vertical Scaling

You can also press the Down Arrow or Up Arrow buttons in the toolbar to change the vertical scaling to see the entire waveform.
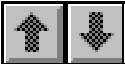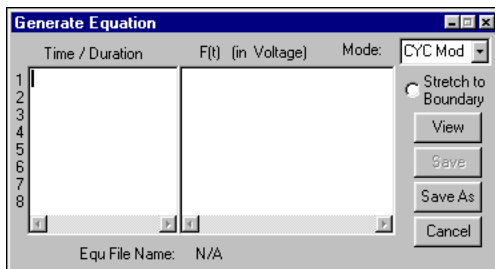
Changing the Timebase

You can also press the Right Arrow or Left Arrow buttons in the toolbar to change the timebase.

Entering Equations to Create Waveforms

You can produce waveforms using the Generate Equation mode (polynomial mode).

To switch to equation mode, select **Create Equation** from the File menu.

The display is blank and ready for math entry.

Equations are entered in two segments, one for its upper voltage level and one for the lower. Each segment is described as a simple statement or directive. The directive defines both the duration of the segment and its voltage.

Equation Example

In the following example, you will create a 1KHz square wave with a maximum peak value of 2V and a minimum peak value of -2V.

1. Click in **Time/ Duration** column and enter 0.5m (for 0.5 milliseconds) for line 1.

2. Click in the **F(t)** column and enter the constant "2" (for +2V).

3. Click in Time/ Duration column again and move the cursor to the end of line 1.

4. Press enter to get to equation line 2 and type in **0.5m**.

5. Click in F(t) column again and move the cursor to the end of line 1.

6. Press enter to get to equation line 2 and type in the constant "-2" (for -2V).

    The equation editor window should look something like this:
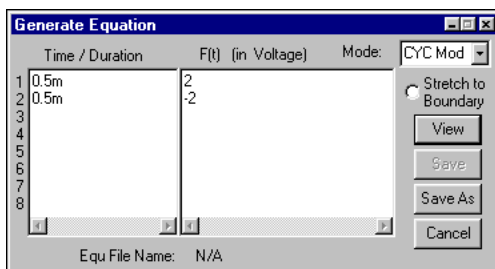
    These directives read: "For 0.5 milliseconds at 2 volts, and for 0.5 milliseconds at -2 volts." The duration of a complete high/low cycle is thus 1 millisecond.

7. Press View to view your signal.
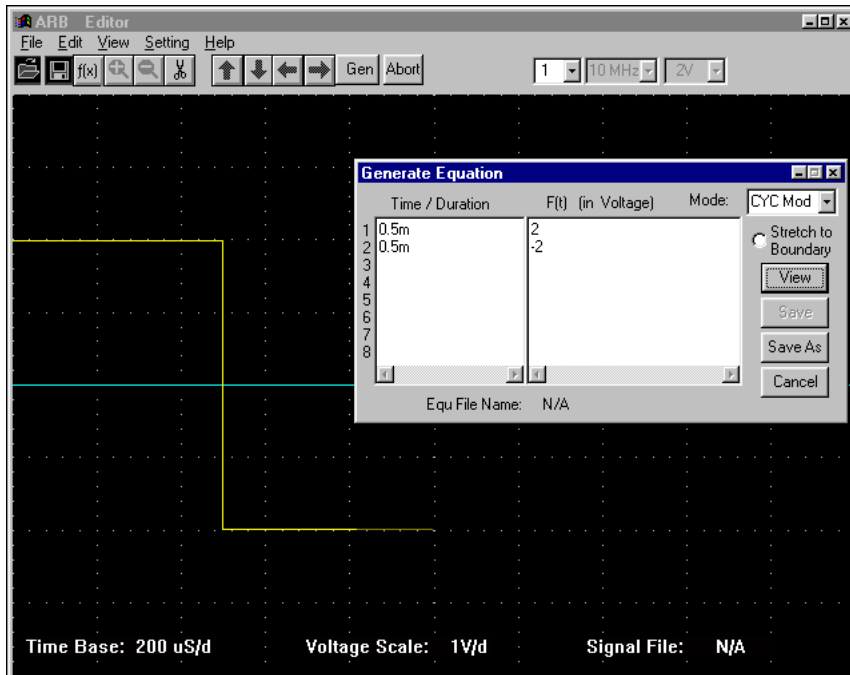
You may need to adjust the vertical scaling or the time base in order to see the entire waveform. In the above example, the time base (horiztonal scale) was set to 200 uS/d and the voltage (vertical) scale was set to 1V/d.

To output your signal to your oscilloscope, press the GEN button. On your scope screen, you will see multiple cycles of the square wave. This is because the CompuGen is free-running, i.e., it is continuously regenerating the one square-wave cycle that you entered.

Equations: Functions and the Variable Time

In the previous example, only constants have been used in the equation statements. You've entered numbers such as 2m, standing for $2*10^{-3}$ seconds, or 2 for 2V, to define the timing and voltage levels of simple waveform segments.

But other instruments also make simple waveforms. What makes the CompuGen for Windows software unique is its built-in set of math functions. These let you simulate virtually any waveform by entering simple mathematical expressions.

The Sine function, for example, creates oscillatory waveforms to simulate radio waves or mechanical vibrations. Sine is a cyclical function, repeating the same basic wave shape over and over.

Ramp Example

The simplest function of time is time itself. For example, enter the equation **2m | t** into the equation editor (2m in the Time/Duration column and the letter "t" in the F(t) column), the voltage at any time equals that time, producing a rising ramp.

This waveform only lasts 2 milliseconds, so the ramp is only 2 millivolts high (0.002V). To create a more visible waveform, multiply this by 1000 to get a 2V ramp by entering **t*1K** in the F(t) column in place of "t". Here the K stands for 1000; you could also have written t*1000.
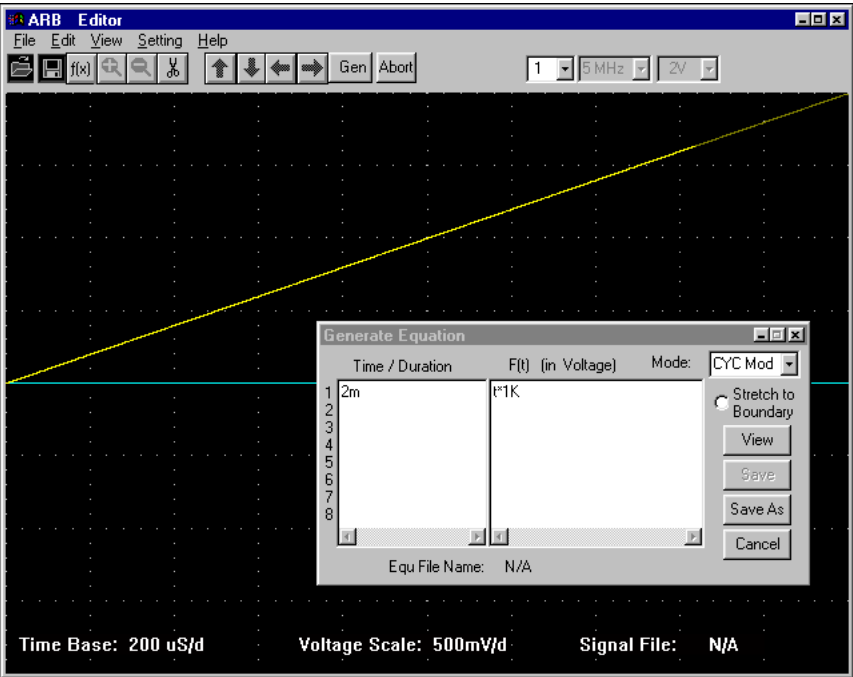
Ramp with Increasing Slope Example

Now you will try a ramp with an increasing slope.

Recall that the formula for a parabola is $\mathbf{y = x^2}$. It works the same as $\mathbf{V = t^2}$. For the equation editor, you have to translate this as:

```
2m | t^(2)
```

Enter 2m in the Time/Duration column and t^2 in the F(t) column.

Note that the ^ sign represents "to the power of"; i.e., $t^2 = t^2$. You could also have entered t*t.

As with the previous example, with only getting as large as 2 x 10^{-3} seconds, the t^2 ramp would only get up to 4 x 10^{-6} volts (4uV). To create a more visible waveform, multiply the result of t^2 by a half million to get a 2V ramp. The final equation would be:

```
2m | (t^(2))*0.5M
```

Enter **2m** in the Time/Duration column and **(t^(2))*0.5M** in the F(t) column.
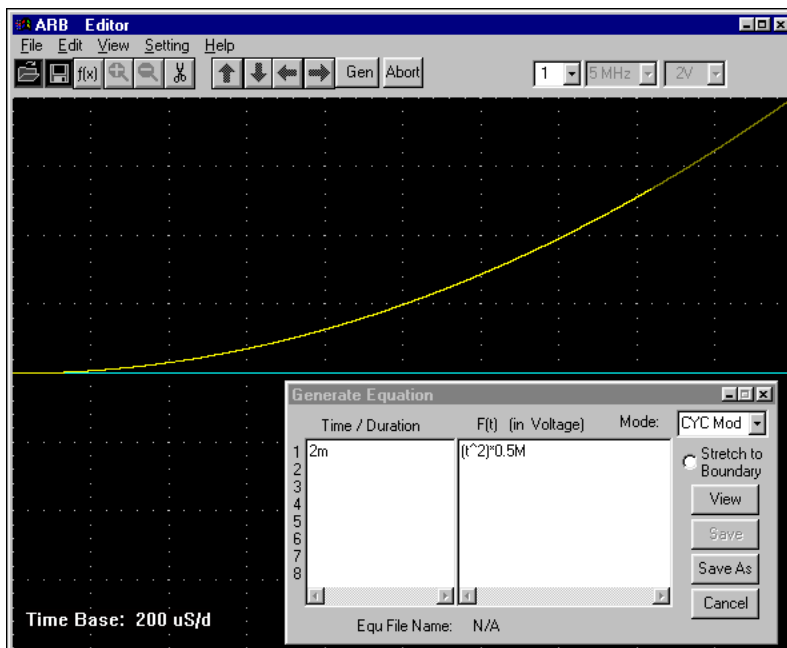
Note the extra parentheses around the **t2** term. This is good practice when exponents are used because of a difference in CompuGen for Windows math you will want to take note of. Unlike the convention that all exponential operations in an equation are evaluated before any multiplication or division, CompuGen for Windows gives equal precedence to multiply, divide, and taking a number to a power.

To ensure that exponentiations always takes precedence, you may want to routinely put a pair of parentheses around each exponential expression. Of course, all three of these functions take precedence over addition and subtraction.

Equations: Radians vs. Cycles (ω vs. π)

Both cycles and radians have advantages in different applications. By default CompuGen for Windows calculates in terms of cycles; to check this for yourself, look at the top right of the Equation Editor window for "Mode".
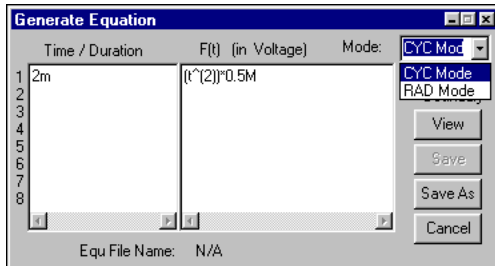
To change to radians, choose **RAD mod** from the Mode drop down menu in the equation editor.

Published trigonometric relationships are generally expressed in terms of radians, not cycles. Switch to Radians mode before entering such equations. Phase and frequency in terms of radians are defined the same way as for cycles, but because one cycle equals 2p radians, the values will be 2p times as great.

The higher frequency based on radians is called the Angular Frequency **ω** (omega) to distinguish it from the common meaning of frequency. The angular frequency **ω** is in units of radians per second. A constant angular frequency can be produced using `sin(w*t)`. CompuGen for Windows will correctly compute **ω** based equations as long as it is in the Radians mode.

The cycle is also a valid unit of angular measurement. It's especially useful in waveform synthesis because desired frequencies are entered without the 2p multiplier required with radians. A 1 kHz sine wave is:

```
sin(1000*t)
```

instead of, in Radians:

```
sin(2*PI*1000*t)
```

Note that "sin" must be in lower case while constants like PI must be in upper case.

Remember also to change the Mode to Radians before doing the second example.

Both of the above equations will yield the same results, as shown on the following page. Remember you may have to adjust the time base and vertical scale to see the whole waveform.