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**User's  
Manual**

**FG410/FG420  
ARBITRARY WAVEFORM  
EDITOR**

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## — Preface —

Thank you for purchasing the **FG410/FG420 Arbitrary/Function Generator**.

To ensure safe use of this product, please first read **Safety Precautions** on the following pages.

### ■ Before Reading This Manual

This manual is a PDF file stored in the CD-ROM. Acrobat Reader (Adobe Systems, Inc.) Ver. 5 or higher is required to view the file contents.

This manual is intended for users with knowledge for basic operation of the operating system (OS) (Microsoft Windows XP / Windows 7 (32bit/64bit)) to be used. For basic operation of the Windows OS or definitions of terms such as “click” and “drag”, see the user’s guide of the Windows OS.

Figures or messages shown in this manual are for the Windows XP environment, and may differ in other environments.

### ■ Caution Symbols Used in This Manual

The following caution symbols are used in this manual. Be sure to observe these caution symbols and their contents.

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#### CAUTION

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This mark indicates cautions on handling of this program.

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- **This manual has the following chapter organization.**

If you are reading this manual for the first time, start from **1. OVERVIEW**.

#### **1. OVERVIEW**

Presents brief descriptions of the “**Arbitrary Waveform Editor**” functions.

#### **2. INSTALLATION**

Describes environmental requirements for operation of the “**Arbitrary Waveform Editor**” as well as its installation and startup procedures.

#### **3. FOR FIRST-TIME USERS**

Describes “**Arbitrary Waveform Editor**” operations, using simple examples of respective major features. Read this chapter while you are operating the editor.

#### **4. Waveform Generation Through PWF**

Describes functions and how to use waveform display screens.

#### **5. OTHER SCREEN OPERATIONS**

Describes functions and how to operate other display screens.

#### **6. ERROR MESSAGES**

Describes error specifications.

#### **7. MAINTENANCE**

Describes management of the CD-ROM and actions to take when the device is damaged.

## — Safety Precautions —

To ensure safe use, be sure to observe the following warnings and cautions.

Yokogawa Test & Measurement Corporation shall not be held liable for damages that arise from failure to observe these warnings and cautions.

- **Be sure to observe the contents of this instruction manual.**

This instruction manual contains information for the safe operation and use of this product.

Be sure to read this information first before using this product.

All the warnings in the instruction manual must be heeded to prevent hazards that may cause major accidents.

- **In case of suspected anomaly**

If the product controlled by this editor emits smoke, an abnormal smell, or abnormal noise, immediately power it off and stop using it.

If such an anomaly occurs, do not use this product until it has been repaired, and immediately report the problem to the location of purchase (either Yokogawa Test & Measurement Corporation or your distributor).

## ———— **Disclaimer** ————

The **Arbitrary Waveform Editor** (hereinafter, “this software”) was shipped after having undergone full testing and inspection by the Yokogawa Test & Measurement Corporation.

Should this product fail due to a manufacturing flaw or due to a mishap during shipping, contact Yokogawa Test & Measurement Corporation or an Yokogawa Test & Measurement Corporation sales representative.

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If a problem occurs or if you have questions, contact Yokogawa Test & Measurement Corporation or the Yokogawa Test & Measurement Corporation sales representative where you purchased this product.

When contacting Yokogawa Test & Measurement Corporation or an Yokogawa Test & Measurement Corporation sales representative, provide the model name (or product name), version number, and information as detailed as possible about the nature of the problem, conditions of use, etc.

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# 1. OVERVIEW

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## 1.1 General

The **Arbitrary Waveform Editor** is software that supports FG410/FG420 Arbitrary/Function Generator arbitrary wave function.

The **Arbitrary Waveform Editor** operates on Windows on a personal computer (PC), transferring waveform and other data via USB.

The main functions of the **Arbitrary Waveform Editor** are listed below.

[Waveform generation function]

Generates standard waveforms in the specified range.

Generates arbitrary waveforms in the specified range using waveform function expressions.

Generates arbitrary waveforms by specifying control points, using linear interpolation and spline interpolation.

Generates arbitrary waveforms by using PWF (parameter-variable waveform).

[Transfer & read-out function]

Transfers waveform data and the main parameter settings of the signal generator via USB.

Reads out the arbitrary waveform data of the signal generator via USB.

[Display function]

Specifies a range with two markers and reads the values of waveforms.

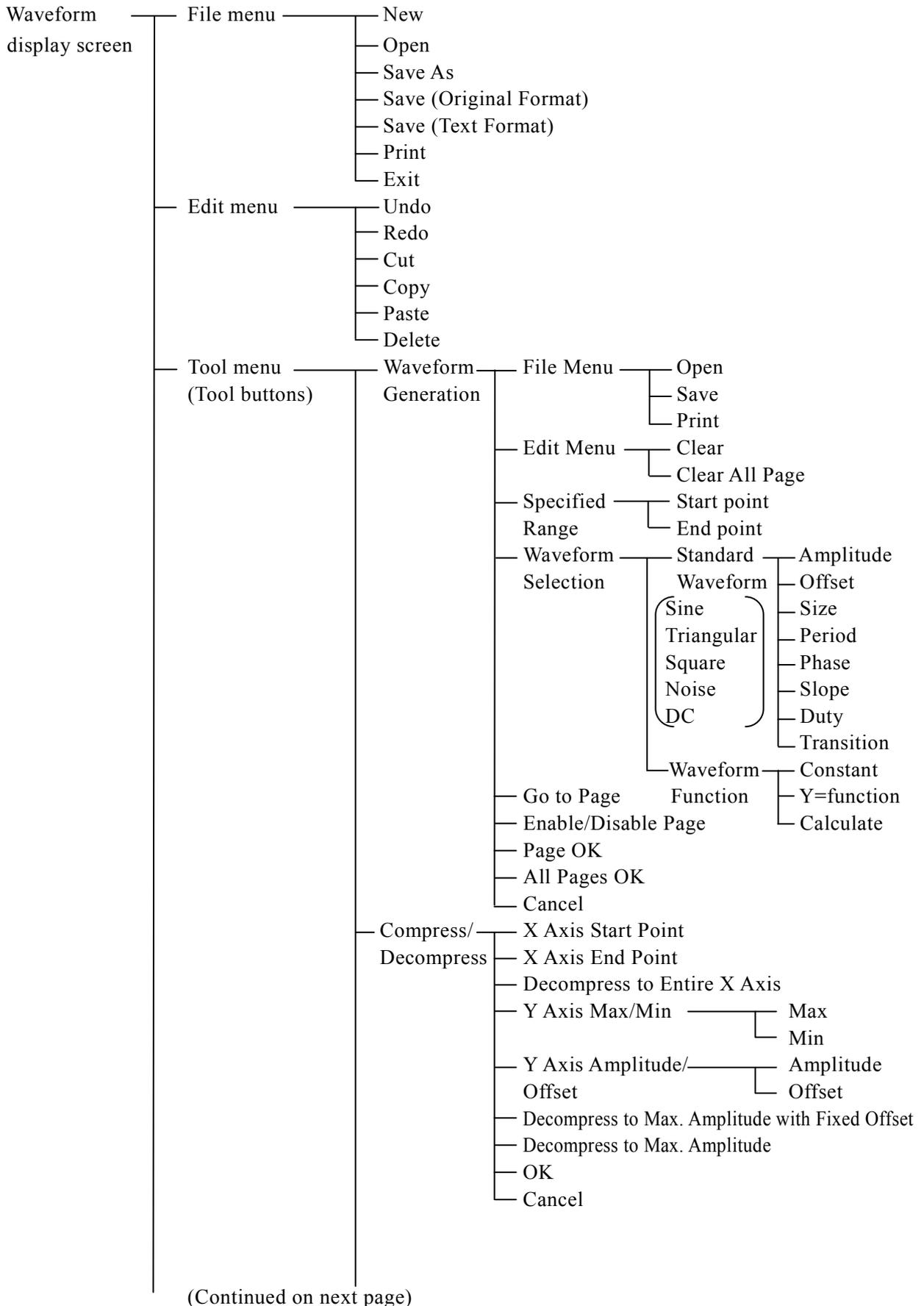
[File operation function]

Saves to a file and reads out waveform data, signal generator settings, waveform function expressions, interpolation control points, etc.

## 1.2 Function Tree

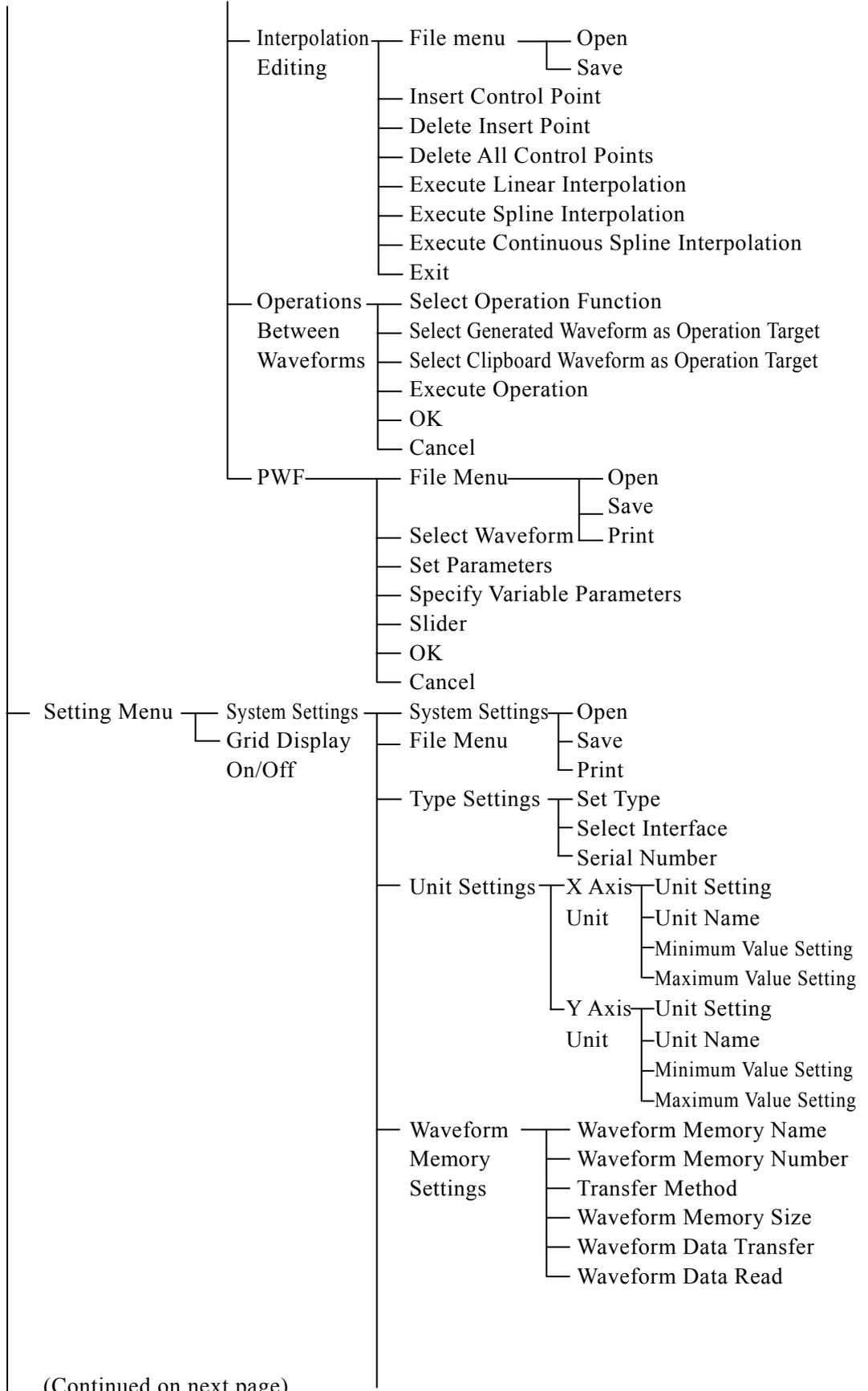
The function tree of the **Arbitrary Waveform Editor** is shown on the following pages.

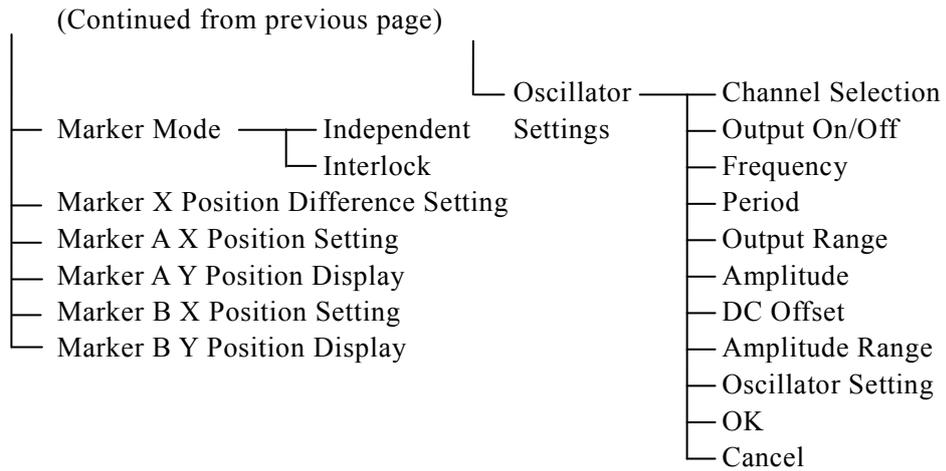
## 1.2 Function Tree



## 1.2 Function Tree

(Continued from previous page)





### 1.3 Conventions

The following conventions are used in this manual.

- Menu names displayed on the screen, user input strings, and other elements: block letters enclosed by square brackets ([, ]).

Examples: **[Function]**, **[s=2\*pi;]**

- Button names displayed on the screen, user's key operations, and other elements: block letters enclosed by a box (□).

Examples: Cancel, OK, Alt

- Press one key while holding down another key: Two keys are connected by a plus (+) symbol. Example: Ctrl + O
- Press one key, release it and press another key: Two keys are divided by a comma (,).

Example: Alt, F



## 2. INSTALLATION

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### 2.1 Hardware Requirements

Before installing the **Arbitrary Waveform Editor**, check that the system satisfies all the requirements below.

#### 2.1.1 Personal computer

- CPU: 300 MHz or faster (1 GHz or faster recommended)
- Memory: 256 MB or more (512 MB or more recommended)
- Free hard disk space: 10 MB or more
- Display: 1024 × 768 pixels or higher and 256 colors or more.
- OS: Windows XP (Microsoft)  
Windows 7 32bit / 64bit (Microsoft)
- Disk drive: CD-ROM drive

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#### **⚠ CAUTION**

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The CD-ROM drive is required only when the software is installed.

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#### 2.1.2 USB interface

- USB 1.1 Full Speed

## 2.2 Installation Procedure

When installing or uninstalling the software in a Windows XP or Windows 7 environment, log on as a user who has an administrator privilege.

### 2.2.1 Installing the USB driver software

The USB driver software can be downloaded from the National Instruments Corporation website. The procedures for installing the USB driver software are described below.

1. Search for the VISA Run-time Engine page on the National Instruments Corporation website or select “VISA driver downloads” at the following URL.  
<http://www.ni.com/support/visa/>
2. Download VISA Run-time Engine from the VISA Run-time Engine page.  
User registration must be performed at this time. Download VISA Run-time Engine Ver. 4.6.2 or later.
3. The downloaded file is a self-extracting file. Extract it and install the software.
4. The USB driver software is installed when installation is successfully complete.

For details, visit the National Instruments Corporation website.

After installing the USB driver software, connect the device to the PC as follows:

- a) Make sure that the device and the PC are not connected.
- b) Power-on the device and connect the device and the PC using a USB cable.
- c) The installation process starts automatically. Follow the guidance.

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#### CAUTION

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If GPIB is selected as the remote interface of the FG410/FG420, select USB and then follow the procedure described above.

For details, refer to the “FG400 Arbitrary/Function Generator Communication Interface User’s Manual”.

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### 2.2.2 Installing Arbitrary Waveform Editor

- (a) Insert the “FG410/FG420 ARBITRARY/FUNCTION GENERATOR” CD-ROM into the CD-ROM drive of the PC.
- (b) Execute **[English\Application\ARB\_EDIT\Setup.EXE]** on the CD-ROM or **[D: \English\Application\ARB\_EDIT\Setup.EXE]** from **[Run]** on the start menu. **[D:]** indicates the CD-ROM drive. If another drive letter is assigned to the CD-ROM driver, assign it appropriately, according to your system.
- (c) Click the **Next** button, following the screen guidance to start installation.
- (d) When installation has been completed, the **Arbitrary Waveform Editor** can be executed. Click **[ARB\_Edit]** from **Start** - **[Programs]** - **[YOKOGAWA]** - **[ARB\_Edit]** to execute the software.

### 2.2.3 Uninstalling Arbitrary Waveform Editor

To remove the Signal/Power Source “**ARB Edit Software**”, first double-click **[Add or Remove Programs]** (in the case of Windows XP, **[Add or Remove Programs]**, in the case of Windows 7, **[Programs and Features]**) from the control panel. Next, click the **[Arbitrary Waveform Editor]** and the **Change/Remove** button.

Note that the folder in which the **Arbitrary Waveform Editor** was installed may not be removed in some cases. All the files created in the folder remain as they are. If the folder is unnecessary, delete it after uninstallation.

## 3. FOR FIRST-TIME USERS

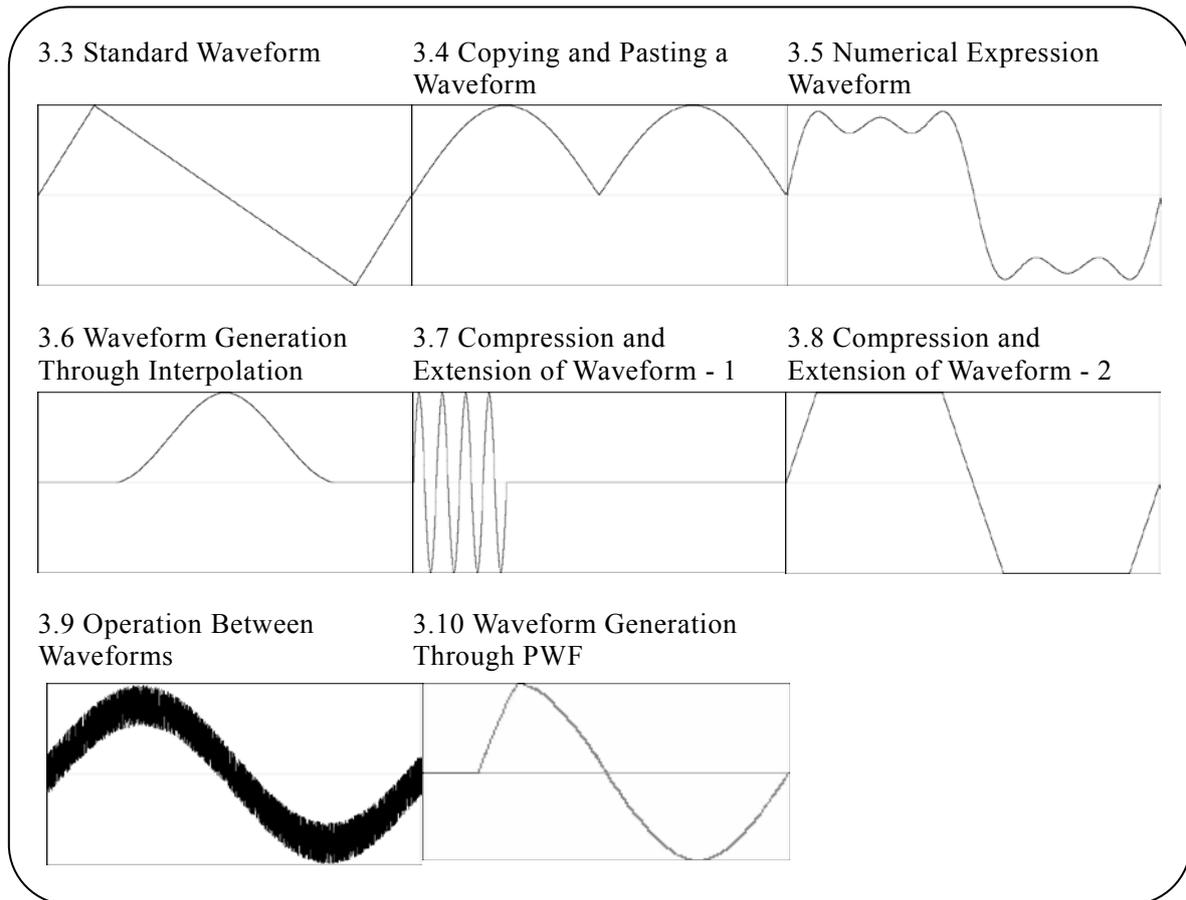
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## 3.1 General

This chapter describes several examples so that you can understand basic operations and functions for the “**ARB Arbitrary Waveform Editor**” (ARB Edit).

It will be easier to understand the description if you read it while actually operating the software.

The following conventions are used in this chapter.



**Figure 3-1 Examples of Waveforms Described in This Chapter**

## 3.2 Start and Termination

Select **[Start]**-**[Program]**-**[YOKOGAWA]** and click **[ARB\_Edit]** to start.

To exit the editor, click **[X]**(close box) at the top right or execute **[File] - [Exit]**. The **[Exit Program. Are you sure?]** confirmation message appears in either case. Click the **[Yes]** button.

In the following examples, operations are explained from the default status when the **Arbitrary Waveform Editor** is started.

Before performing the operations in each example, exit the **Arbitrary Waveform Editor** once and then restart it.

## 3.3 Standard Waveform

This section explains how to create a triangle wave with 30% symmetry, as a sample standard waveform.

Step 1: Click **[f\*]** at the top left of the screen. The same result can be obtained when **[Tools] - [Wave Create]** is selected.

The screen titled **[YOKOGAWA ARB Edit - Wave Create]** appears.

Step 2: Click the **[v]** button to the right of **[Function]** and click **[Triangle]** from the list.

Step 3: Change the numerical value from **[50]** to **[30]** in the number input section to the right of **[Symmetry]** and press the **[Enter]** key. This specifies a triangle wave with 30% symmetry.

Step 4: Clicking **[All Page OK]** closes the waveform generation screen and returns to the screen where the waveform is displayed.

Explanation 1: In this example, the waveform is generated across the memory size.

In the “ARB Edit”, the waveform can be divided into multiple pages. For example, the first quarter of a waveform can be allocated to the first page and the latter half of the waveform can be allocated to the second page, and so on.

 See “5.1.1 Range setting and page”.

To execute the specified waveform across multiple active pages in batch, click the **[All Pages OK]** button.

To execute the displayed page only, click the **[Page OK]** button.

In this example, clicking either of the buttons leads to the same result because the first page alone is specified.

Explanation 2: In addition to the triangle wave, the sine wave, square wave (duty ratio variable), and waveform definitions (waveform functions) with the noise, DC, or numerical expression can be selected.

Waveform function example:  See “3.5 Numerical Expression Waveform”.

## 3.4 Copying and Pasting a Waveform

This section explains how to create a full-wave rectification waveform, as a sample of copying and pasting waveforms.

Step 1: Click the  button to the top left of the screen. The same result can be obtained when **[Tools] - [Waveform Create]** is selected.

Step 2: The sine wave is selected in the initial status, so click the **All Page OK** button without changing it and return to the waveform display screen.

Step 3: Move marker B to the center of waveform.

In the initialized state, **[1.000000]** is displayed to the bottom right of the screen.

Set **[0.5]**, which is the half of the memory size, in the number area to the right of **[MrkB(X)]** and press the **Enter** key.

Step 4: Press the **C** key while holding down the **Ctrl** key. The same result can be obtained when **[Edit] - [Copy]** is selected. The area between markers A and B, that is, the first half data of waveform is copied to the clipboard.

Step 5: Click  (option button) to the left of **[Interlock]**, making it  (selected status) to set the interlock mode to the marker.

Set **[0.5]** in the number area to the right of **[MrkA(X)]** and press the **Enter** key.

Step 6: Press the **V** key while holding down the **Ctrl** key. The same result can be obtained when **[Edit] - [Paste]** is selected.

The waveform data on the clipboard is pasted to the latter half of waveform.

Explanation 1: If the axis setting is not in the initial state, the operation differs.

In this case, exit **ARB Edit** and then restart it and perform the operation.

Explanation 2: The operation of pressing the **C** key while holding down the **Ctrl** key is hereinafter expressed as **Ctrl + C**.

**Ctrl + C** (Copy) leaves the waveform in the copied area as is.

**Ctrl + X** (Cut) is the same in that the data in the selected area is saved onto the clipboard. The waveform in the selected area is deleted, however.

**Ctrl + D** (Delete) deletes the waveform in the selected area but the data on the clipboard does not change.

Explanation 3: Use markers A and B to select the range.

For example, when the range specified with the markers is from 0 to 1.000, the actual selection range will be  $0 \leq X < 1.000$ .

Explanation 4: For the clipboard, see  "4.7.2 Clipboard" and your Windows OS manual.

## 3.5 Numerical Expression Waveform

This section explains how to create a waveform by superposing 3rd and 5th harmonics over the fundamental wave, as a sample of generating a waveform with a numerical expression.

Step 1: Select **[Setup]** - **[Setup]**.

The screen titled **[YOKOGAWA ARB Edit - System Setup]** appears.

Step 2: Click the **[Unit]** page tab.

Step 3: Click the  button to the right of **[X-Axis Unit]** and click **[User Unit]** from the displayed list.

Leave the minimum value to the maximum value two lines below as their initial values, **[0.000000 - 1.000000]**.

Step 4: Click the  button to the right of **[Y-Axis Unit]** and click **[User Unit]** from the displayed list.

Leave the minimum value to the maximum value in the last line as their initial values, **[-1.000 - 1.000]**.

Step 5: Click the  button to return to the waveform display screen.

Step 6: Click the  button at the left top of the screen.

Step 7: Click the  button to the right of **[Function]** and click **[Waveform Function]** from the displayed list.

Step 8: Input **[s=2\*pi;]** in the input area to the right of **[Constant]**.

Input **[sin(x\*s)+sin(x\*s\*3)/3+sin(x\*s\*5)/5]** in the input area to the right of **[Y=]**.

Step 9: Click the  button. The calculated waveform is displayed on the waveform generation screen.

Step 10: Click the  button to return to the waveform display screen.

Explanation 1: In this example, the horizontal line (X) is treated as 0 to 1 by using the custom unit.

Likewise, the vertical line (Y) is treated as  $\pm 1$  as a whole.

The expression of one cycle of the sine wave is made easier by defining  $s=2\pi$  as a constant so that **[x\*s]** is expressed in a formula.

Explanation 2: If you set the X range for the custom unit to 0 to 6.283185 ( $2\pi$ ) at step 3, the expression becomes simpler: **[sin(x)+sin(x\*3)/3+sin(x\*5)/5]**.

## 3.6 Waveform Generation Through Interpolation

This section explains how to create a smooth pulse waveform, as a sample of generating a waveform through interpolation.

Step 1: Select **[Setup] - [Setup]** to display the dialog box titled **[YOKOGAWA ARB Edit - System Setup]**. Next, click the **[Unit]** page tab.

Step 2: Click the  button to the right of **[X-Axis Unit]** and click **[User Unit]** from the displayed list. Leave the minimum value to the maximum value two lines below as their initial values, **[0.000000 - 1.000000]**. Click the  button to the right of **[Y-Axis Unit]** and click **[User Unit]** from the displayed list. Leave the minimum value to the maximum value two lines below as their initial values, **[-1.000000 - 1.000000]**.

Click the **[OK]** button to return to the waveform display screen.

Step 3: Set **[0.2]** in the number area to the right of **[MrkA(X)]** and press the **[Enter]** key.  
Set **[0.8]** in the number area to the right of **[MrkB(X)]** and press the **[Enter]** key.

Step 4: Click the  button at the top left of the screen. The same result can be obtained when **[Tools] - [Interpolate]** is selected.

The screen titled **[YOKOGAWA ARB Edit - Interpolate]** appears.

Step 5: Click the cell for the Y value next to X which shows **[0.5]** on the list of the control points, input 1, and press the **[Enter]** key.

Step 6: Click the **[Cont Spline]** button.

The interpolated waveform is displayed on the waveform display screen.

If the waveform is hidden behind the interpolation editing screen and difficult to see, move the screen.

Step 7: Click the **[Exit]** button to return to the waveform display screen.

Explanation 1: If the setting in step 1 and step 2 is already the default setting, no operation is required.

Explanation 2: The point set at step 5 is called “**control point**” in interpolation editing.

Explanation 3: In the case of linear interpolation, the waveform is created by interpolating spaces between control points with straight line.

In the case of a spline, spaces between control points are smoothly interpolated with spline curve.

Explanation 4: In the case of a continuous spline, the selected range is interpolated so that it is smoothly connected to the previous and subsequent ranges as well.

When all ranges are selected, the waveform is interpolated so that the head and tail of the waveform can be smoothly connected if the waveform is repeated.

## 3.7 Compression and Extension of Waveform - 1

This section explains how to create a burst waveform by contracting the sine wave to the first quarter of the waveform display screen, as a sample of horizontally contracting/extending a waveform.

Step 1: Click the  button at the top left of the screen.

A sine wave is selected in the initial status.

Change the numerical value to the right of **[Period]** from **[1]** to **[4]** to make a sine wave with four cycles.

Click the **All Page OK** button to return to the waveform display screen.

Step 2: Click the  button at the top left of the screen. The same result can be obtained when **[Tools] - [Compress/Decompress]** is selected.

The screen titled **[YOKOGAWA ARB Edit - Compress/Decompress]** appears.

Step 3: In the initial status, **[1.000000]** is displayed to the right bottom of the waveform display screen.

Leave the number area to the right of **[Start X=]** as **[0.0]**.

Set the quarter of memory size, **[0.25]** in the number area to the right of **[End X=]** and press the **Enter** key.

The four sine waves displayed across the waveform are contracted to the first quarter on the waveform display screen.

If the waveform is hidden behind the contraction/extraction screen and difficult to see, move the screen.

Step 4: Click the **OK** button to return to the waveform display screen.

Explanation 1: **[Start X=]** is left as **[0]** in this example, so the original waveform is contracted to the first quarter of waveform on the waveform display screen.

For example, when **[Start X=]** is set to **[0.25]** and **[End X=]** is set to **[0.5]**, the original waveform is contracted to the second quarter on the waveform display screen.

Explanation 2: It is also possible to specify the whole waveform.

Select a part of waveform on the waveform display screen with markers A and B in advance.

If the **Fit Length** button is then clicked on the contraction/extraction screen, the selected range is extended to the whole waveform.

## 3.8 Compression and Extension of Waveform - 2

This section explains how to create a trapezoidal wave by extending and clipping a triangle wave, as a sample of vertically contracting/extending a waveform.

Step 1: Click the  button at the top left of the screen.

A sine wave is selected in the initial status.

Click the  button to the right of **[Function]**, click **[Triangle]** from the displayed list.

Click the **All Page OK** button to return to the waveform display screen.

Step 2: Click the  button at the top left of the screen. The same result can be obtained when **[Tools] - [Compress/Decompress]** is selected.

The screen titled **[YOKOGAWA ARB Edit - Compress/Decompress]** appears.

Step 3: Change the setting in the number area to the right of **[Max.(X)]** from **[1.0]** to **[3.0]** and press the **Enter** key.

Change the setting in the number area to the right of **[Min.(N)]** from **[-1.0]** to **[-3.0]** and press the **Enter** key.

The triangle wave is vertically extended, clipped and changed to a trapezoidal wave on the waveform display screen.

If the waveform is hidden behind the contracting/extension screen and difficult to see, move the screen.

Step 4: Click the **OK** button to return to the waveform display screen.

Explanation 1: It is also possible to vertically contract or move the waveform by specifying the maximum and minimum numerical values at step 4.

If the positive and negative full scales are exceeded as a result of extension or move, the waveform is clipped to the positive and negative full scales.

Explanation 2: It is possible to contract/extract part of a waveform by selecting the part on the waveform display screen with Markers A and B in advance.

Explanation 3: If the waveform has not reached the positive and negative full scales, the waveform can be extended to the maximum amplitude by clicking the **Fit Amplitude** or **Fit Peak-Peak** button.

Explanation 4: The vertically reversed waveform can be obtained by setting **[-3.0]** as the maximum value and **[3.0]** as the maximum value at step 3.

Explanation 5: Though the contraction/extraction ratio is specified with **[Max/Min]** in this example, **[Amp/Offs]** can also be used to specify this ratio.

Click  (option button) to the left of **[ Amp/Offs]** making it  (selected status). The result same as in this example can be obtained by setting **[Amplitude]** to **[6.0]** and **[DC Offset]** to **[0]**.

Explanation 6: Though the triangle wave is clipped to create a trapezoidal wave in this example, it is possible to generate the trapezoidal wave more easily by setting **[Transition]** on a square wave.

## 3.9 Operation Between Waveforms

This section explains how to create a waveform by superposing noise over a sine wave, as a sample of operation between waveforms.

Step 1: Click the  button at the left top of the screen.

A sine wave is selected in the initial status.

Change the numerical value to the right of **[Amplitude]** from **[2.0]** to **[1.5]** to reduce the amplitude a little bit.

Click the **All Page OK** button to return to the waveform display screen.

Step 2: Click the  button at the top left of the screen. The same result can be obtained when **[Tools] - [Operate]** is selected.

The screen titled **[YOKOGAWA ARB Edit - Operate]** appears.

Step 3: Click the **Created Waveform** button in the middle of the inter-waveform operation screen.

The screen titled **[YOKOGAWA ARB Edit – Waveform Create]** appears as when the  button is clicked.

Step 4: Click the  button to the right of **[Function]** and click **[Noise]** from the displayed list.

Change the numerical value to the right of **[Amplitude]** from **[2.0]** to **[0.4]**.

Click the **Page OK** button to return to the inter-waveform operation screen.

Step 5: When the  button is clicked, the waveform created as a result of addition of the sine wave and noise is displayed in the waveform display area to the right of the screen.

Step 6: Click the **OK** button to return to the waveform display screen.

The waveform superposing noise over the sine wave is now created.

Explanation 1: Besides the addition shown in this example, subtraction, multiplication, and division are possible.

Explanation 2: The operation can be executed targeting a part of the waveform by selecting the part on the waveform display screen with markers A and B in advance.

Explanation 3: In this example, the waveform created on the waveform generation screen is used for operation.

The data on the “clipboard” can be used by clicking the **Clip Board** button in step 3.

Clipboard:  See “3.4 Copying and Pasting a Waveform”.

Explanation 4: It is convenient to set the vertical axis to  $\pm 1$  of the custom as in the example in “3.5 Numerical Expression Waveform” when executing multiplication.

Under this setting, the result of multiplying full scale values will also be a full scale value.

## 3.10 Waveform Generation Through PWF

An example using “On-Ph Ctrl Sine” is shown below as an example of waveform generation through PWF.

Step 1: Click the  button at the top left of the screen. The same result can be obtained when **[Tools]-[PWF]** is selected.

The screen titled **[YOKOGAWA ARB Edit - Parameter-Variable Waveform Create]** appears.

Step 2: Click the  button to the right of **[Function]**, and then click **[On-Ph Ctrl Sine]** in the list.

Step 3: Click the  button to the right of **[Parameter-Variable Waveform]**, and then click **[SlopeT]** in the list.

Step 4: Either change the numerical value from **[10]** to **[20]** in the number input section to the right of **[SlopeT]** or move the slide bar to the right of **[Parameter-Variable Waveform]** to change the waveform.

Step 5: Click  to close the PWF screen and return to the waveform display screen.

Explanation 1: The PWF screen, the waveform is generated across the entire memory size.

Explanation 2: Twenty-five different waveforms can be used with PWF. The number of parameters to be set depends on the waveform. See “5.5 PWF (Parameter-Variable Waveforms)”.

 “5.5 PWF (Parameter-Variable Waveform)”

## 4. OPERATIONS ON ARBITRARY WAVEFORM DISPLAY SCREEN

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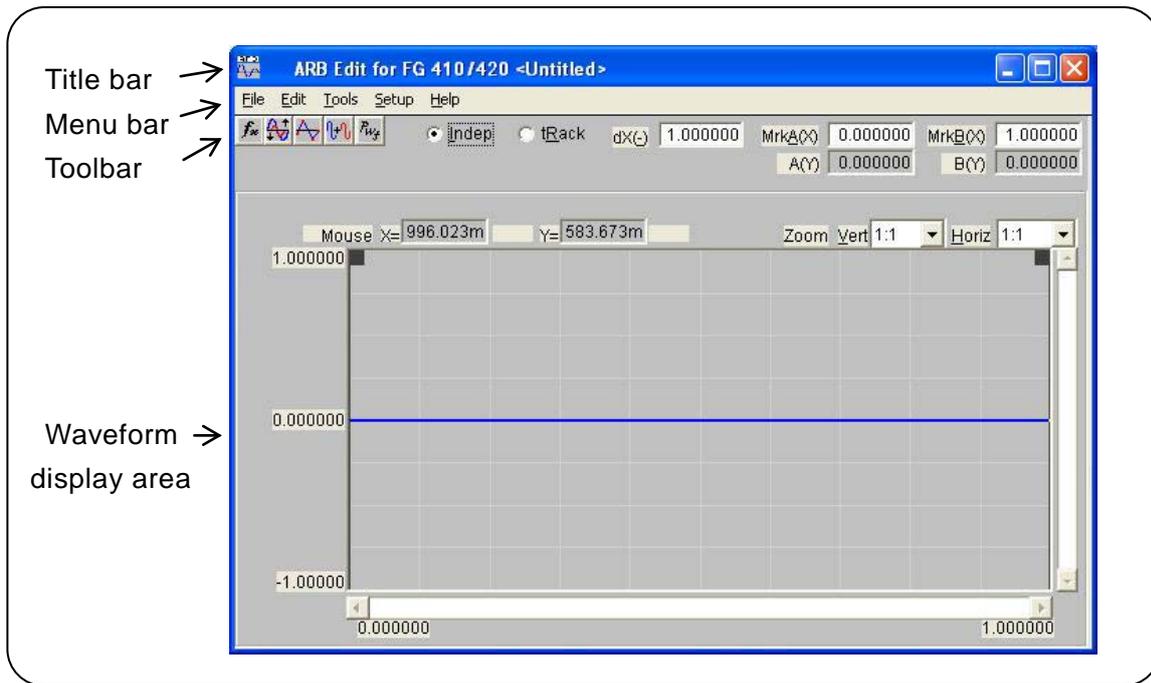
The display that appears when the “**ARB Arbitrary Waveform Editor**” is started is called the waveform display screen.

How to start:  See “3.2 Start and Termination”.

This chapter describes the functions and operations on the waveform display screen.

### 4.1 Organization and Functions of Waveform Display Screen

“**Figure 4-1 Waveform Display Screen**” shows the names of each component on the waveform display screen.



**Figure 4-1 Waveform Display Screen**

The title bar displays the file name from/to which waveform data was read/written. If no file has been read or written, [**<Untitled>**] is displayed.

For standard functions, operation methods, and other information on title bar buttons, see the Windows manual.

The menu bar has a pull-down menu.

Clicking a menu name displays the menu options. Clicking an option executes that function.

Otherwise, pressing the **[Alt]** key and pressing the key for the underlined alphabetic character to the right of the menu name displays the options for the menu (for example, **[Alt], [F]** displays the options for the **[File]** menu). Clicking the key for the underlined alphabetic character to the right of the option executes that function.

If **[Ctrl + \*]** (\*: an alphabetic character) is displayed to the right of the menu option, the corresponding function can be directly executed when the menu option is not displayed. (For example, **[Ctrl + V]** is displayed to the right of **[Paste]** on the **[Edit]** menu. In this case, pressing

**Ctrl** + **V** is the same operation as selecting **[Edit] - [Paste]**.)

The toolbar contains the frequently used function buttons and the marker setting/display section.

 : Waveform create screen	 See“5.1 Generation of Standard Waveform and Numerical Expression Waveform”.
 : Compress/Decompress screen	 See“5.2 Contraction/Extension of Waveform”.
 : Interpolate screen	 See“5.3 Waveform Generation Through Interpolation”.
 : Operate screen	 See“5.4 Operation Between Waveforms”.
 : PWF screen	 See“5.5 PWF (Parameter-Variable Waveform)”.

<input type="radio"/> <b>I</b> ndep], [ <input type="radio"/> <b>t</b> Rack]:	Selects the marker operation mode.
<b>[dX(-)]</b> :	Sets/displays the difference in the horizontal position of marker.
<b>[MrkA(X)], [MrkB(X)]</b> :	Sets/displays the horizontal position of marker.
<b>[A (Y)], [B (Y)]</b> :	Displays the vertical position of the waveform at the marker position.

The waveform display area contains the waveform display, display magnification (zoom) ratio selection, and the mouse pointer position display.

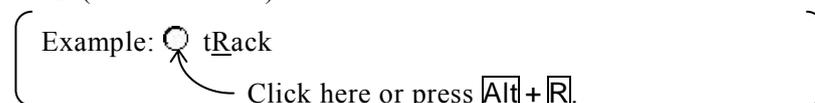
If an underlined alphabetic character is displayed to the right of the item name on the toolbar or in the waveform display area, pressing the underlined alphabetic character while holding down the **Alt** key selects the corresponding item.

For example, **Alt** + **H** (pressing the **H** key while holding down the **Alt** key) selects **[Horiz Zoom]**. Note that **Alt**, **H** (pressing the **Alt** key and then pressing the **H** key) displays the **[Help]** menu options on the menu bar.

Clicking the input/display area to the right of the item name also selects that item.



Clicking  (option button) to the left of the item name selects the function and the option button turns to  (selected status).



## 4.2 Tool Menu

The tool menu options are shown below.

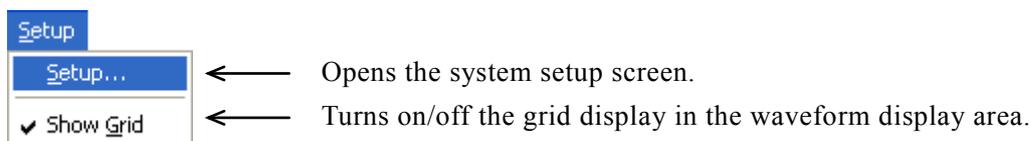
<div style="background-color: #4a7ebb; color: white; padding: 2px; margin-bottom: 5px;">Tools</div> <div style="background-color: #e6e6e6; padding: 2px; margin-bottom: 5px;">Wave Create...</div> <div style="background-color: #e6e6e6; padding: 2px; margin-bottom: 5px;">Compress/Decompress</div> <div style="background-color: #e6e6e6; padding: 2px; margin-bottom: 5px;">Interpolate...</div> <div style="background-color: #e6e6e6; padding: 2px; margin-bottom: 5px;">Operate...</div> <div style="background-color: #e6e6e6; padding: 2px;">PWF</div>	<p>← Opens the waveform create screen, as does the  button on the toolbar.</p> <p>← Opens the compress/decompress screen, as does the  button on the toolbar.</p> <p>← Opens the interpolate screen, as does the  button on the toolbar.</p> <p>← Opens the operate screen, as does the  button on the toolbar.</p> <p>← Opens the operate screen, as does the  button on the toolbar.</p>
--	---

For example, pressing **[Alt]**, **[T]**, **[C]** opens the waveform generation screen.

Waveform create screen	 See “5.1 Generation of Standard Waveform and Numerical Expression Waveform”.
Compress/decompress screen	 See “5.2 Contraction/Extension of Waveform”.
Interpolate screen	 See “5.3 Waveform Generation Through Interpolation”.
Operate screen	 See “5.4 Operation Between Waveforms”.
PWF screen	 See “5.5 PWF (Parameter-Variable Waveform)”.

## 4.3 Setting Menu

The setting menu options are shown below.



Selecting **[Setup] - [Setup]** (**[Alt]**, **[S]**, **[S]**) opens the system setup screen.

On the system setup screen, it is possible to select the signal generator model, set or transfer main parameters, transfer waveform data, set the display unit, or perform other operations.

 See “5.6 Transferring the Waveform and Settings”.

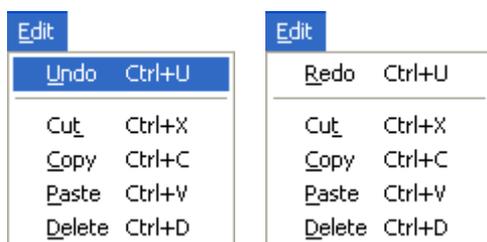
Each time **[Setup] - [Show Grid]** (**[Alt]**, **[S]**, **[G]**) is selected, the grid display in the waveform display area is turned on or off.

No grid is printed out when a waveform is printed out.  See “4.6.5 Print”.

## 4.4 Undo and Redo

In the “ARB Edit”, it is possible to revert the waveform creation or editing operation to the previous status (Undo). Select **[Edit] - [Undo]** (**[Alt]**, **[E]**, **[U]**) or pressing **Ctrl + U** undoes the operation.

To cancel the Undo operation (Redo), select **[Edit] - [Redo]** (**[Alt]**, **[E]**, **[R]**) or press **Ctrl + U**.



## 4.5 Zooming and Scrolling the Display

### 4.5.1 Vertical zoom

The waveform display can be independently zoomed vertically or horizontally.

The vertical magnification ratio can be [1:1] (display the whole waveform), [1:2] (display the half of waveform to the full screen), [1:4]... up to [1:256].

Click the  button to the right of **[Zoom Vert]** and select the desired item from the display magnification ratio list.

To increase the magnification ratio, press **[Alt] + [V]**, select **[Zoom Vert]**, and press the  or  key.

To decrease the magnification ratio, press the  or  key. The **[Home]** key cancels zooming and the **[End]** key zooms the waveform to maximum.

### 4.5.2 Horizontal zoom

The horizontal magnification ratio can be [1:1] (display the whole waveform), [1:2] (display the half of waveform to the full screen), [1:4]... up to [1:128].

Click the  button to the right of **[Horiz]** and select the desired item from the displayed magnification ratio list.

To increase the magnification ratio, press **[Alt] + [H]**, select **[Horiz]** and press the  or  key. To

decrease the magnification ratio, press the  or  key. The **[Home]** key cancels zooming and the **[End]** key zooms the waveform to maximum.

### 4.5.3 Scrolling

When the vertical/horizontal ratio is [1:2] or greater, the scroll button appears on the scroll bar.

Drag the scroll button with the mouse to observe other parts of waveform.

The scroll button starts blinking when clicked. Pressing the  or  key in this status moves the display position to the right or downward. Pressing the  or  key moves the display position to the left or upward. Pressing the **[PageUp]**/**[PageDown]** moves the display position by a larger step.

The **[Home]** key moves the display position to the leftmost or upmost position and the **[End]** key moves the display position to the rightmost or downmost position.

### 4.5.4 Marker and range selection

The markers are used to select the horizontal waveform range before editing or creating waveforms.

The markers are also used to specify the horizontal position to read the vertical value of the waveform.

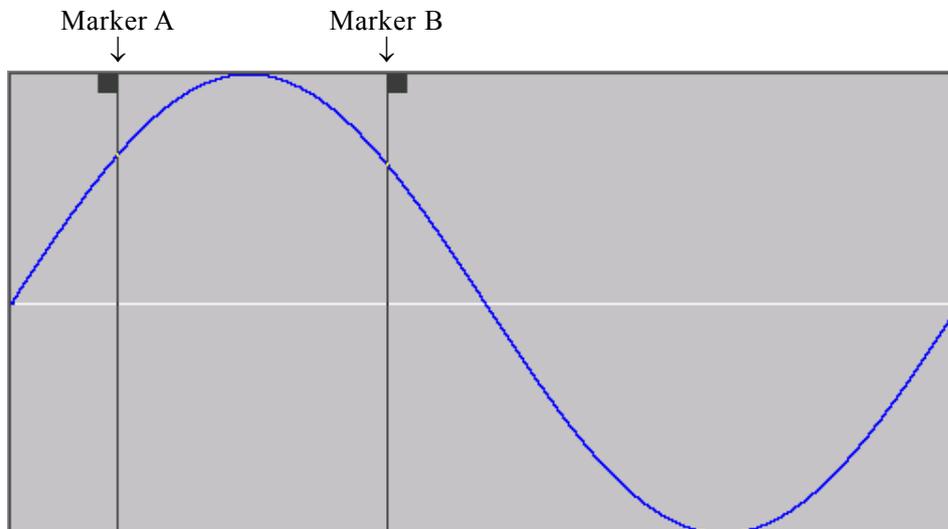
The **ARB Edit** markers are displayed as vertical lines in the waveform display area.

## 4.5.5 Marker operations

### a) Marker types

There are two markers used in the **ARB Edit**: marker A and marker B.

Marker A cannot be set to the right of marker B. marker A must be always to the left of or at the same position as marker B.



The position of each marker is displayed to the right of **[MrkA(X)]** and **[MrkB(X)]**.

The waveform value to the marker position is displayed to the right of **[A(Y)]** and **[B(Y)]**.

### b) Moving the marker (mouse dragging)

The marker can be moved in two ways: mouse dragging and numerical value specification.

Moving the mouse cursor to the same horizontal position as the marker, the shape of the mouse cursor changes from  to . Dragging the mouse in this status moves the marker. Though the marker is difficult to see to the right or left edge, moving the mouse cursor to either edges makes the cursor to .

When the marker is moved by mouse dragging, the waveform data address is used as the moving unit.

When one dot on the display corresponds to multiple addresses due to the display magnification ratio, the address corresponding to one dot on the display is used as the moving step.

### c) Marker moving (numerical value setting)

For marker position specification with a higher resolution, directly input the marker position with a numerical value.

Clicking the right space to **[MrkA(X)]** or pressing **[Alt] + [A]** selects the position display section of marker A. Inputting a numerical value followed by pressing the **[Enter]** key jump marker A to the specified position.

To specify the marker position in higher resolution, directly input a numeric value as the marker position.

Likewise, to jump marker B to the specified position, click the right space to **[MrkB(X)]** or press **[Alt] + [B]** and input a numerical value in the marker B position display section, and then press the **[Enter]** key.

By setting a numerical value, it is possible to freely specify the marker position within the setting/display resolution range without being restricted by the waveform data address.

### d) Marker interlock mode

When  (option button) to the left of [ **I**ndep] on the toolbar is selected () , markers A and B independently move.

Clicking the option button to the left of [**t**Rack] or pressing **Alt** + **R** interlocks marker A and marker B.

The horizontal difference between marker A and marker B is displayed to the right of [**dX**(-)].

When either of the markers is moved, the other marker is also moved with the distance between them being kept.

Click the right space to [**dX**(-)] or press **Alt** + **-** and input a numerical value, and then press the **Enter** key to jump marker B so that the distance between the markers becomes the specified value.

## 4.5.6 Range selection

The range selected with the marker is effective in the following operations:

- Copy/cut/paste range of waveform  See “4.7 Copy and Paste”.
- Contraction/extension range  See “5.2 Contraction/Extension of Waveform”.
- Range to generate the waveform through interpolation  See “5.3 Waveform Generation Through Interpolation”.
- Inter-waveform operation range  See “5.4 Operation Between Waveforms”.

## 4.5 Zooming and Scrolling the Display

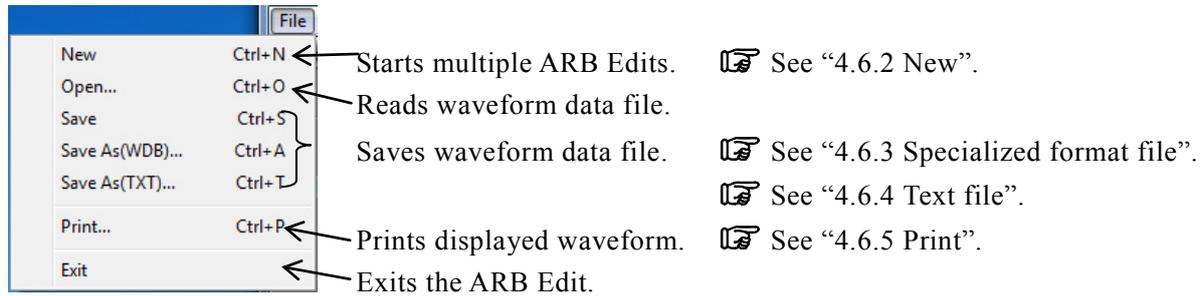
---

To be exact, the marker exists just before the set/displayed horizontal axis position (the numerical value display to the right of **[MrkA(X)]** or **[MrkB(X)]**).

For example, when the horizontal axis position for marker A is 5 and that for marker B is 10, the selection range will be  $5 \leq X < 10$ . Marker A is located just before 5, so 5 is between marker A and marker B. Marker B is located just before 10, so 10 is not between marker A and marker B.

## 4.6 File Operations and Printing

The file menu options are shown below.



The file name used for reading or saving is displayed on the title bar.

### 4.6.1 File types

ARB Edit can read/write the following types of files. The text between parentheses is the file extension to be added to each file type.

- Specialized format file containing waveform data, signal generator settings, and display unit settings (.wdb)  See "4.6.3 Specialized format file".
- Text file containing waveform data only (.txt)  See "4.6.4 Text file".
- Specialized format text file containing standard waveform types as well as parameters, numerical expression waveform's constants and expressions (.wfn)  See "5.1.5 File operation".
- Text file containing control points only (.prn)  See "5.3.3 File operation".
- Original format text file of PWF parameter information (.PWF)  See "5.5.4 File operation".
- "ARB Edit" specialized format file containing signal generator settings, display unit settings and other data (.ocb)  See "5.6.6 File operations".

### 4.6.2 New

Selecting **[File] - [New]** (**[Alt], [F], [N]** or **[Ctrl]+[N]**) starts another "ARB Edit". The new "ARB Edit" starts in the same position as where the first "ARB Edit" started.

It is possible to exchange data between "ARB Edits" via the clipboard.

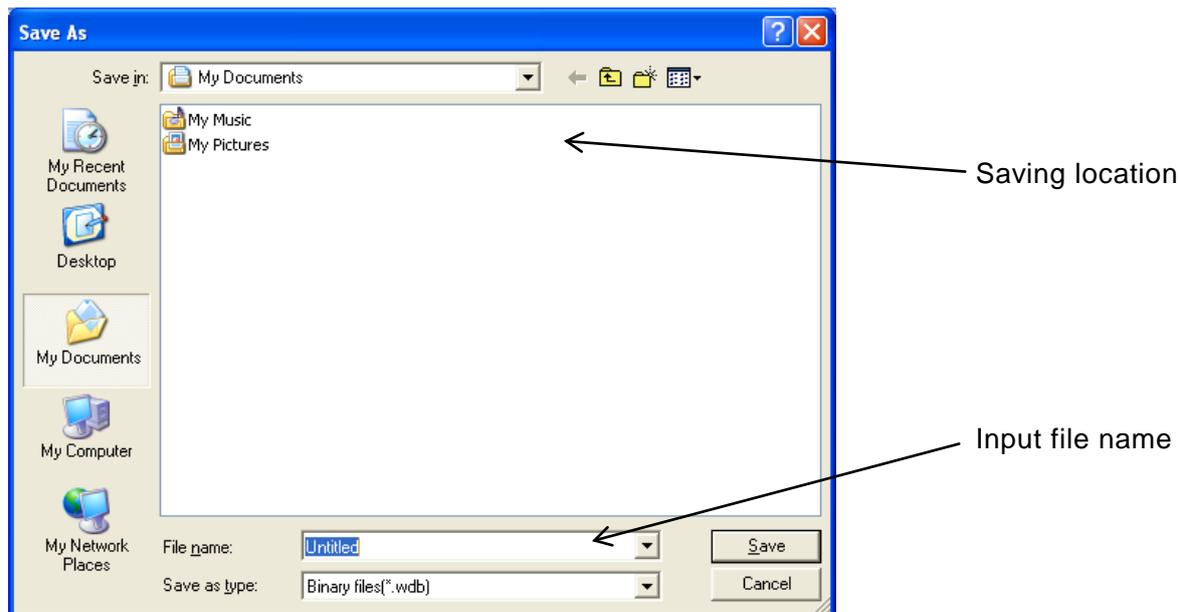
 See "4.7.2 Clipboard" and "5.4.2 Object of operation".

### 4.6.3 Specialized format file

Almost all necessary information such as waveform data created using the **ARB Edit**, signal generator's settings, and display unit setting can be saved to a file in batch. This is an original format binary file with a smaller size than a text file.

Selecting [**File**] - [**Save As(WDB)**] (**Alt**, **F**, **A** or **Ctrl** + **A**) displays the screen titled [**Save As**].

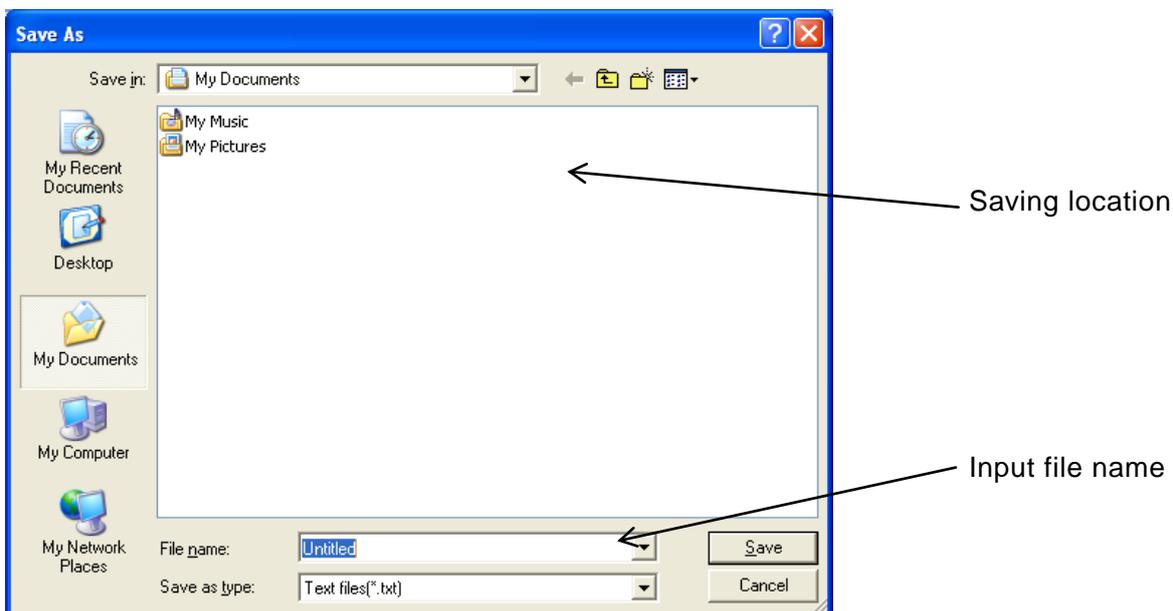
Select a saving location, input a file name, and click the **Save** button. The file extension is “.wdb” and can be omitted during file name input.



### 4.6.4 Text file

Waveform data created using the “ARB Edit” can also be saved in a text file so that other applications can easily handle it.

Selecting [**File**] - [**Save As(TXT)**] (**Alt**, **F**, **T** or **Ctrl** + **T**) displays the screen titled [**Save As**].



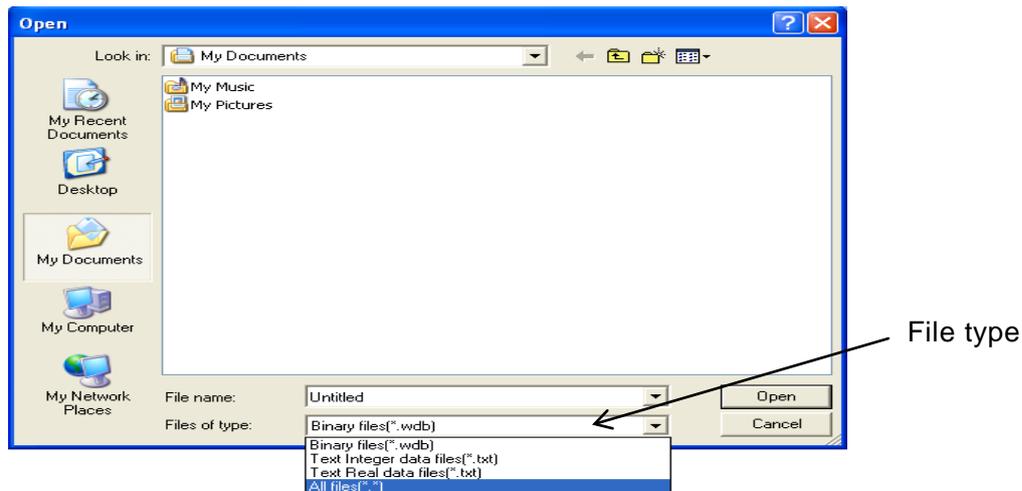
Select a saving location, input a file name and click the **Save** button. The file extension is “.txt” and can be omitted during file name input.

### a) Integer number format text file

If the waveform data created with **ARB Edit** is saved to a text file, the resulting file is a whole number format text file.

To read the text file created with **ARB Edit**, select **[File]-[Open]** (**Alt**, **F**, **O** or **Ctrl** + **O**). A screen titled **[Open]** appears.

In **[Files of type]**, select **[Text Integer data files (\*.txt)]** and specify the file name.



In the integer number format text file, 16-bit (0 to +65535) data is saved as a numeric string. One row contains one numerical string data unit.

This file can be read as is using a text editor.

Otherwise, the **ARB Edit** can read the text file created using the text editor. When creating an integer number format text file, put one data unit, which must be a 16-bit signed integer (–32768 to +32767), on one row.

The number of data units in a data file should be 524288 or smaller. If the number of data units in a data file is larger than 524288, cannot be read.

If the number of data units is smaller than the system setting, extension is done to the entire waveform.

### b) Real format text file

Besides text files created with **ARB Edit**, it is also possible to read text files described in real number format.

When **[File]-[Open]** (**Alt**, **F**, **O** or **Ctrl** + **O**) is selected, a screen titled **[Open]** appears. In **[Files of type]**, select **[Text Real data files (\*.txt)]** and specify the file name.

When creating a real number format text file, do so that there is 1 data per line. Restrictions regarding the number of data are the same as for whole number format text files.

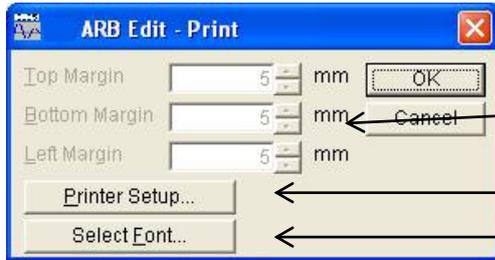
### 4.6.5 Print

Waveform data created using the **ARB Edit** can also be printed out as a waveform. However, note that the grid is not printed out.  See “4.3 Setting Menu”.

Selecting **[File] - [Print]** (**[Alt], [F], [P]** or **[Ctrl] + [P]**) displays the screen titled **[YOKOGAWA ARB Edit - Print]**.

Make settings for the printer or font as needed and click the **[OK]** button.

The upper, lower, and left margins cannot be set when printing the waveform.



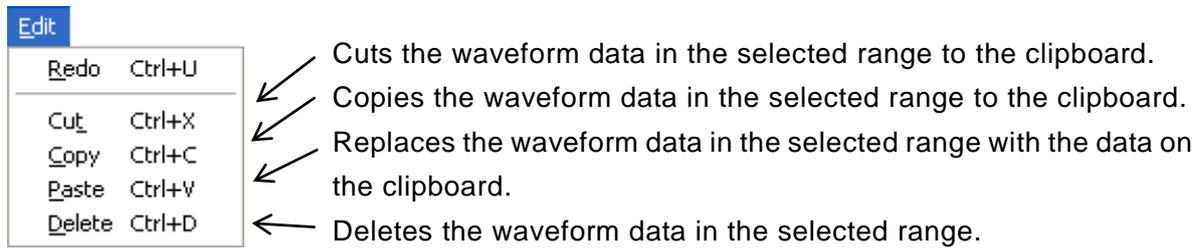
Margin setting is invalid when printing the waveform.

Printer settings

Font specification

## 4.7 Copy and Paste

In the **ARB Edit**, waveform data can be edited using the cut, copy, and paste functions.



### 4.7.1 Edit operation

- Cut → **[Edit] - [Cut]** ( **[Alt], [E], [T]** or **[Ctrl] + [X]** )
- Copy → **[Edit] - [Copy]** ( **[Alt], [E], [C]** or **[Ctrl] + [C]** )
- Paste → **[Edit] - [Paste]** ( **[Alt], [E], [P]** or **[Ctrl] + [V]** )
- Delete → **[Edit] - [Delete]** ( **[Alt], [E], [D]** or **[Ctrl] + [D]** )

For details on each editing operation, see “Figure 4-2 Waveform Editing Operation”.

### 4.7.2 Clipboard

Executing the cut or copy operation sends the waveform data in the selected range to the clipboard. The clipboard is a temporary data storage area provided in Windows.

The waveform data in the selected range is sent to the clipboard. The data equivalent to 16 bits (–32768 to +32767) is regarded as one data unit contained in one numerical row.

Data on the clipboard can be pasted as is to the text editor, spreadsheet software, or other application or pasted within that “ARB Edit” or other “ARB Edit” when multiple ARB Edit s are operating.

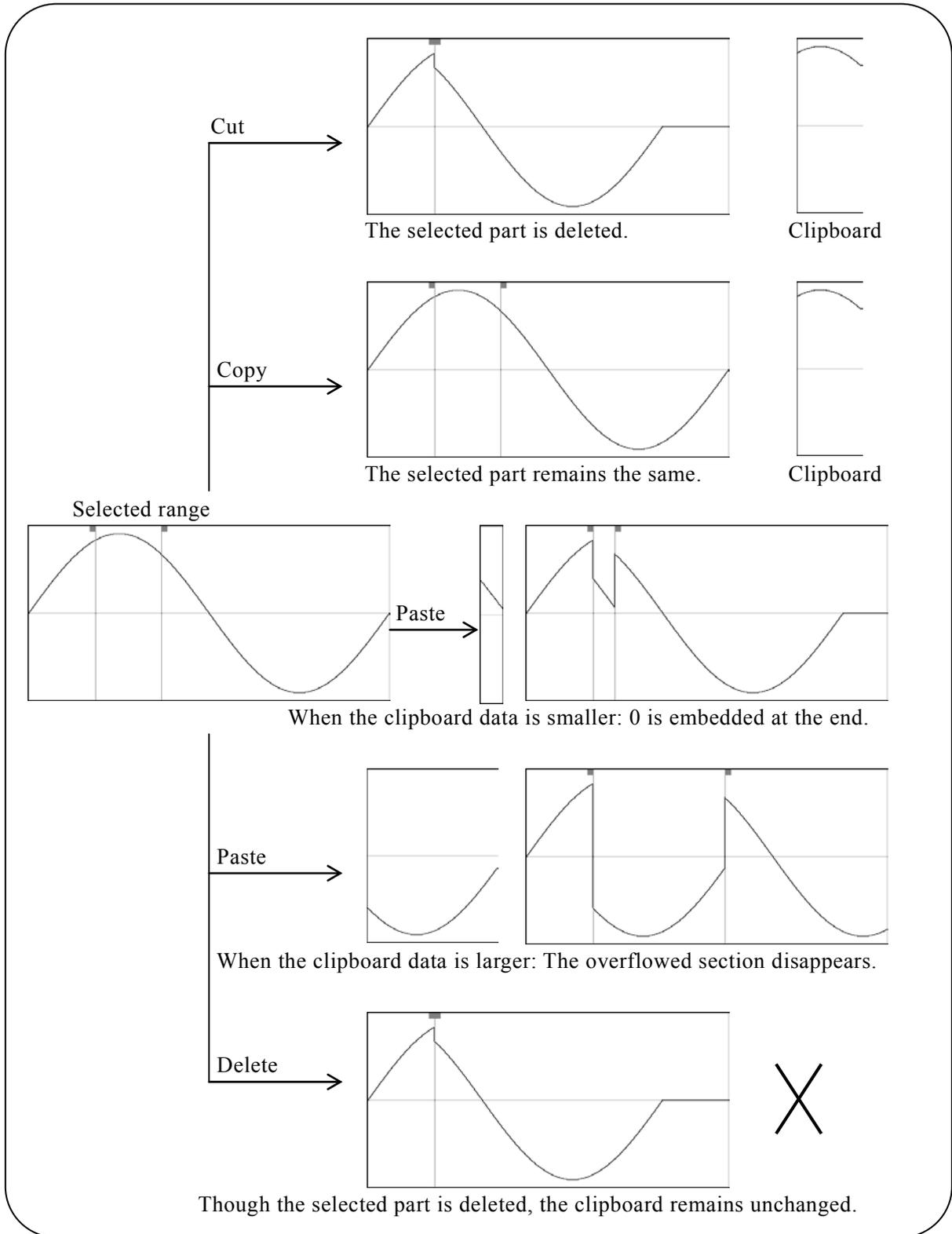


Figure 4-2 Waveform Editing Operation





## 5. OTHER SCREEN OPERATIONS

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This chapter describes the functions and operations on each screen other than the waveform display screen.

How to start each screen:  “4.1 Organization and Functions of Waveform Display Screen”  
(toolbar description)

 “4.2 Tool Menu”

### 5.1 Generation of Standard Waveform and Numerical Expression Waveform

The waveform generation screen is used to generate the standard waveform and numerical expression waveform.

Click the  button on the toolbar or select **[Tool] - [Wave Create]** (**Alt**, **T**, **C**) to open the waveform generation screen.

Immediately after returning to the waveform display screen after creating a waveform on the waveform generation screen, the status before waveform creation can be recovered by selecting **[Edit] - [Undo]** (**Alt**, **E**, **U**), or pressing **Ctrl** + **U**.

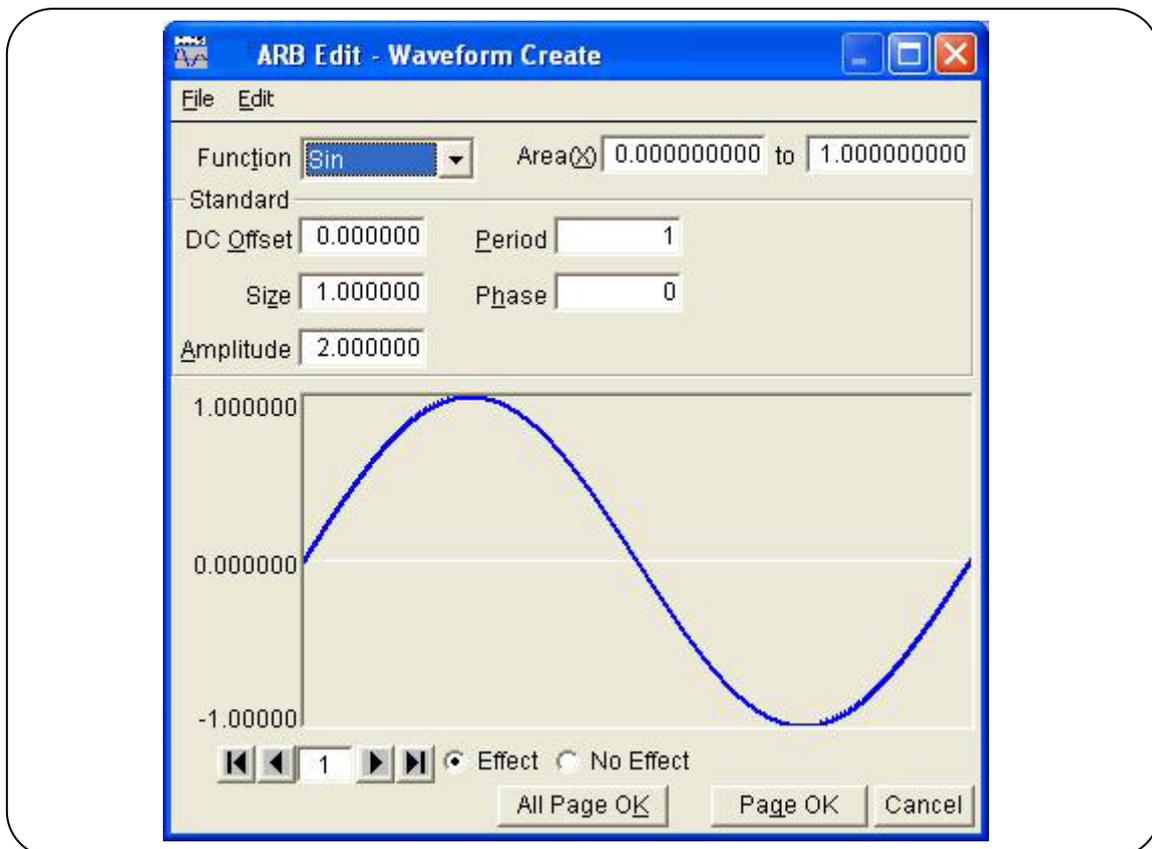


Figure 5-1 Waveform Generation Screen

### 5.1.1 Range setting and page

On the waveform generation screen, it is required to specify the independent “range” and “waveform definition” for each page to create a waveform. (Range specification with the markers on the waveform display screen hardly effects the waveform generation screen.)

Set the range for each page in the two numerical input areas to the right of **[Area(X)]**.

If there are duplicated ranges for multiple pages, the waveform definition for a larger page number (later one) takes effect. Using this characteristic, it is possible to change on the later page the part of the waveform defined on one of the first pages.

Each page can be independently enabled or disabled. Click either  (option button) in **[Effect]** or **[No Effect]** to the bottom of the screen to make it  (selected status).

To move the page, use the  and  buttons at the bottom left of the waveform generation screen. Clicking the  button moves to the previous page and clicking the  button moves to the next page.

Clicking the  button jumps to the first active page and clicking the  button jumps the last active page.

Directly input a number in the numerical value input area between the buttons and press the  key to jump to the specified page. The page numbers range from 1 to 200.

To return the settings on the displayed page to the default values, select **[Edit] - [Page Clear]** (, , ) on the waveform generation screen.

To return all pages to the default values at once, select **[Edit] - [All Page Clear]** (, , ) on the waveform generation screen.

To create the waveform on the displayed page only, click the  button at the bottom of the screen.

To create waveforms on all pages, click the  button.

To return to the waveform display screen without creating a waveform, click the  button at the bottom of the screen or press the  key.

The maximum number of pages is 200.

### 5.1.2 Waveform selection

Clicking the  button to the right of **[Function]** on the waveform generation screen lists available waveforms. Select a waveform by clicking it.

The waveform can be also selected by pressing  + , selecting **[Function]** and then selecting the  key/ key ( key/ key).

The noise is generated based on the random number calculation, so different waveform data is created at each generation.

DC makes the specified range the same data.

The waveform function defines the waveform with a numerical expression.

 “5.1.4 Inter-Waveform Numerical Expression”

### 5.1.3 Parameter setting

The parameters in “Figure 5-1 Waveform Generation Screen” can be set for sine waves, triangle waves, square waves, noise, and DC.

**Table 5-1 Parameters for Standard Waveforms**

	Sine Wave	Triangle Wave	Square Wave	Noise	DC
DC <u>O</u> ffset	○	○	○	○	○
<u>S</u> ize	○	○	○	○	○
<u>A</u> mplitude	○	○	○	○	–
<u>P</u> eriod	○	○	○	–	–
<u>P</u> hase	○	○	○	–	–
Sym <u>m</u> etry	–	○	–	–	–
Duty <u>R</u> atio	–	–	○	–	–
Tran <u>s</u> ition	–	–	○	–	–

The size can be calculated by subtracting (lower limit) from (upper limit) of the range specification (X) on the page. When the size is changed, the upper limit of range specification is changed.

The amplitude is the peak to peak value.

The cycle specifies how many cycles (waves) of the waveform in the range are to be created.

The phase unit is ° (degree).

For the triangle wave, the inclination (symmetry) can be set. The inclination unit is %.

For the square wave, the duty ratio and transition can be set. The duty ratio unit is %. The transition sets the time for the wave height value to go between 0% and 100% with the ratio to the cycle (%).

If the **[DC Offset]** or **[Amplitude]** setting exceeds the ± full scale value, the waveform is clipped at the ± full scale value.

When the mouse cursor is moved to the waveform display area on the waveform generation screen, the shape of mouse cursor changes to  or .

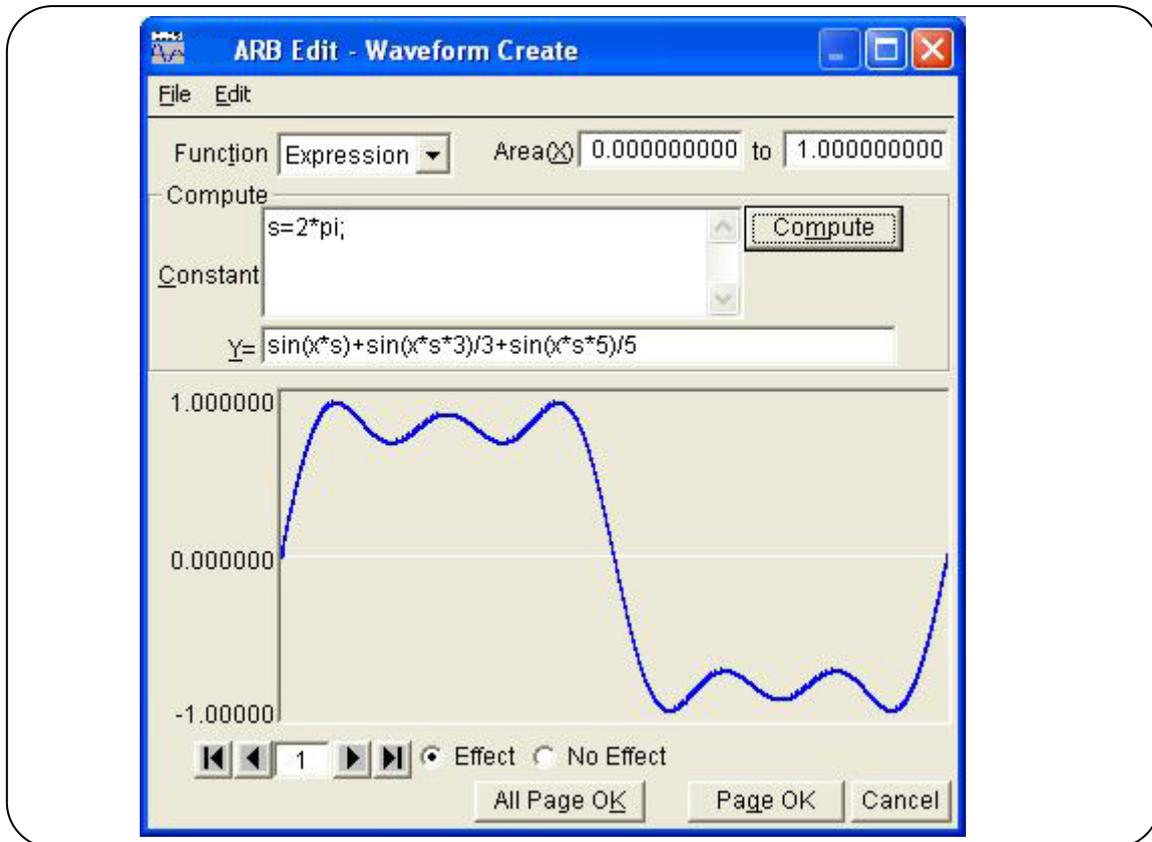
Dragging the mouse in the  status vertically or horizontally moves the waveform. **[DC Offset]** is changed by vertical operations and **[Phase]** is changed by horizontal operations.

Dragging the mouse in the  status vertically or horizontally extends or compress the waveform. **[Amplitude]** is changed by vertical extension/compression and **[Period]** is changed by vertical extension/compression.

Using  or  enables you to intuitively set parameters while looking at the waveform. It is also possible to roughly make settings in this way and then set a more accurate value by inputting numerical values.

### 5.1.4 Inter-Waveform Numerical Expression

Selecting **[Waveform Function]** in “5.1.2 Waveform selection” displays the constant input section **[Constant]** and numerical expression input section **[Y=]**.



**Figure 5-2 Waveform Generation Screen - Waveform Function**

Input the constant and expression and click the **[Compute]** button to check the calculated waveform in the waveform display on the waveform generation screen.

To create the waveform on all pages in the batch, click the **[All Page OK]** button at the bottom of the screen.

To create the waveform on the displayed page only, click the **[Page OK]** button at the bottom of the screen.

To return to the waveform display screen without creating a waveform, click the **[Cancel]** button at the bottom of the screen or press the **[Esc]** key.

#### a) Constants

Describe the constant in the **[constant=value or expression]** format such as **[fs=32767;]** and **[s=2\*pi/4096;]**. Be sure to suffix a constant definition or expression with **[;]**.

Use 1-byte characters for the constant or expression. Constants and expressions are not case sensitive.

The constant should begin with an alphabetic character and consist of alphanumeric characters.

Constants must be strings other than those shown in “Table 5-4 Built-in Functions”. It is

recommended to use strings different from those in “Table 5-2 Built-in Constants”.

When the **All Page OK** button is clicked, the constant takes effect on the page where the constant is defined and subsequent pages.

For example, the constant defined on the first page affects all the pages. The constant defined on the third page affects the third and subsequent pages, but not the first and second pages.

When the waveform on the displayed page is created with the **Page OK** button, the constant affects the displayed page only. For example, the constant defined on the second page does not affect the first and third pages.

To use the constant on other pages, click the **Compute** button to execute calculation on the page where the constant is defined in advance.

### b) Built-in constants

The constants shown in “Figure 5-2 Waveform Generation Screen - Waveform Function” were included into **ARB Edit** at factory.

If the constant defined in “a) constant” has the same name as the built-in constant, the defined value or expression takes effect.

**Table 5-2 Built-in Constants**

Name	Meaning	Value
pi	Circle ratio	3.1415926535898
c	Light speed	2.99792458e8
h	Planck constant	6.6260755e-34
k	Boltzmann constant	1.380658e-23
r	Euler constant	0.57721566490153

### c) Functions

Specify a numerical expression in the  $Y=f(X)$  format in the numerical expression input section **[Y=]**.

Here, “X” is a value that varies within the range of the page. For example, when the page range is 1000 to 2000, **[X]** in the expression changes between 1000 and 2000.

The **[X]** value in the numerical expression is affected by the horizontal axis unit of the system setting screen settings.

 “5.6.2 Axis unit setting”

For example, assume that expressions such as **[Y=]** or **[sin (x)]** are used to specify a sine wave. The argument for the sin() function is a radian expression.

Assume that the horizontal axis unit is **[Address]** and the range is between 0 and 8,192. Because  $8,192 = 2 * \pi * 1303.797\dots$ , the result of this expression is a sine wave with approximately 1,304 waves.

## 5.1 Generation of Standard Waveform and Numerical Expression Waveform

When the horizontal axis unit is **[Time]** and the cycle is 1 ms, the result of the expression will be  $1e-3 = 2*\pi*0.0001591\dots$ , a value that barely changes around the  $0^\circ$  of sine wave.

If the vertical axis unit is **[User Unit]** and 0 to 1, the result of the expression will be  $1 = 2*\pi*0.1591\dots$ , waveform of about one/sixth of the former half of sine wave.

To create the simplest expression to obtain one cycle of a sine wave, set the horizontal axis unit to **[User Unit]** and the range between 0 and 6.283185.

The **[Y=]** value in the numerical expression is affected by the vertical axis unit set on the system setting screen.  “5.6.2 Axis unit setting”

For example, assume that expressions such as **[Y=]** or **[sin(x)]** are used to specify the sine wave.

The value for the sin() function is  $\pm 1$ .

When the vertical axis unit is **[Data]**, the range is between  $-32768$  and  $+32767$ . Therefore, the result of this expression is a waveform with a very small amplitude close to 0.

When the vertical axis unit is **[Voltage]** and the amplitude is 20 Vp-p, the range is  $\pm 10$ , so the result of this expression is 1/10 of a full-scale sine wave.

When the vertical axis unit is **[User Unit]** and the range is between  $-1$  and  $+1$ , the result of this expression is a full-scale sine wave.

If the calculation results exceed the  $\pm$  full-scale range, the waveform is clipped at the  $\pm$ full-scale range.

### d) Operators

The operators in “Table 5-3 Operators” can be used in the constant input section **[Constant]** and numerical expression input section **[Y=]**.

The order of operator priority ranges from top (highest) to bottom (lowest).

The logical operator returns 1 when the condition is true and 0 when the condition is 1.

**Table 5-3 Operators**

Operator	Associativity	Remark
( ), function	→	
+ - !	←	Monadic operator, ! is a logical operator
^	→	Binary operator, exponential
* /	→	Binary operator, multiplication/division
+ -	→	Binary operator, addition/subtraction
< <= > >=	→	Logical operator, size comparison
== !=	→	Logical operator, Equivalence comparison
&&	→	Logical operator, AND
	→	Logical operator, OR



## 5.1 Generation of Standard Waveform and Numerical Expression Waveform

- One cycle of square wave (horizontal axis: user unit 0 to 6.283185, vertical axis: user unit -1 to +1)

Page 1 **[Constant]**      **[None]**      **[Y=]**  $(((\sin(x))\geq 0)-0.5)*2$

(Obtain 0/+1 square wave using the logical operator “>=” and convert it to ±1.)

- DC sweep waveform (horizontal axis: user unit 0 to 1, vertical axis: user unit -1 to +1)

Page 1 **[Constant]**      **[s=2\*pi;]**      **[Y=]**  $[(x-0.5)+\sin(x*s*32)]/2$

- Damped wave (horizontal axis: user unit 0 to 6.283185, vertical axis: user unit -1 to +1)

Page 1 **[Constant]**      **[None]**      **[Y=]**  $[\exp(-x)*\sin(x*64)]$

- DSB waveform (horizontal axis: user unit 0 to 6.283185, vertical axis: user unit -1 to +1)

Page 1 **[Constant]**      **[a=19.5;]**      **[Y=]**  $[(\sin(a*x)+\sin(b*x))/2]$   
**[b=20.5;]**

- CR charge-discharge waveform (horizontal axis: user unit 0 to 1, vertical axis: user unit -1 to +1)

Page 1 **[Area(X)]**      **[0]** to **[0.5]**

**[Constant]**      **[j=15;]**      **[Y=]**  $[1-2*\exp(-x*j)]$

Page 2 **[Area(X)]**      **[0.5]** to **[1]**

**[Constant]**      **[j=15;]**      **[Y=]**  $[-1+2*\exp(-(x-0.5)*j)]$

- Differentiation waveform (horizontal axis: user unit 0 to 1, vertical axis: user unit -1 to +1)

Page 1 **[Area(X)]**      **[0]** to **[0.5]**

**[Constant]**      **[j=15;]**      **[Y=]**  $[\exp(-x*j)]$

Page 2 **[Area(X)]**      **[0.5]** to **[1]**

**[Constant]**      **[j=15;]**      **[Y=]**  $[-\exp(-(x-0.5)*j)]$

- Magnetic head waveform: Gaussian pulse (horizontal axis: user unit -1 to 1, vertical axis: user unit -1 to +1)

Page 1 **[Area(X)]**      **[-1]** to **[0]**

**[Constant]**      **[j=32;]**      **[Y=]**  $[\exp(-((x+0.5)^2)*j)]$

Page 2 **[Area(X)]**      **[0]** to **[1]**

**[Constant]**      **[j=32;]**      **[Y=]**  $[-\exp(-((x-0.5)^2)*j)]$

- Magnetic head waveform: Lorentz waveform (horizontal axis: user unit 0 to 6.283185, vertical axis: user unit -1 to +1)

Page 1 **[Constant]**      **[None]**      **[Y=]**  $[(\sin(x)-\sin(x*3))/3+\sin(x*5)/5]/1.533333333$

- Waveform where surge is superimposed around 180° (horizontal axis: user unit 0 to 1, vertical axis: user unit -1 to +1)

Page 1 **[Area(X)]**            **[0]** to **[1]**

**[Constant]**            **[s=2\*pi;]**            **[Y=] [sin(s\*x)]**

Page 2 **[Area(X)]**            **[0.49]** to **[0.51]**

**[Constant]**            **[j=50;]**            **[Y=] [sin(s\*x)+cos(s\*j\*x)/2+0.5]**

(Create a sine wave across page 1 and overwrite the surge waveform on page 2.)

### 5.1.5 File operation

The settings on the waveform generation screen are saved in a text file.

Selecting **[File] - [Save]** (**[Alt]**, **[F]**, **[S]** or **[Ctrl] + [S]**) on the waveform generation screen displays the screen titled **[Save As]**.

Select a saving location, input a file name and click the **[Save]** button. The file extension is “.wfn” and can be omitted at file name input.

To read a file containing the waveform generation screen settings, select **[File] - [Open]** (**[Alt]**, **[F]**, **[O]** or **[Ctrl] + [O]**).

When the screen titled **[Open]** appears, select a file location, input a file name and click the **[Open]** button.

Because the file containing the waveform generation screen settings is a text file, the file can be edited using a text editor or other application, though this operation is not recommended.

As a result of editing, the file may be not able to be normally read. For example, the format may change to one that **ARB Edit** cannot read or the expression may become too long, exceeding the limit.

Other files that ARB Edit can handle  “4.6.1 File types”

### 5.1.6 Print

The setting conditions for the waveform generation screen can be also printed out.

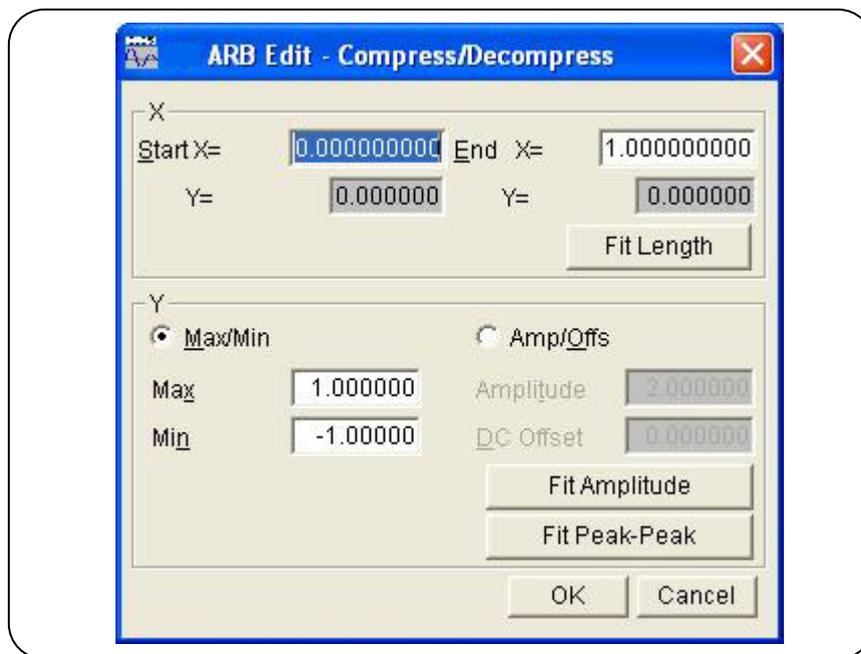
Selecting **[File] - [Print]** (**[Alt]**, **[F]**, **[P]** or **[Ctrl] + [P]**) displays the screen titled **[YOKOGAWA ARB Edit - Print]**.

Make settings for the upper, lower and left margins, the printer or font as needed and click the **[OK]** button.

## 5.2 Contraction/Extension of Waveform

The compression/decompression screen is used to vertically or horizontally contract or extend the waveform in the selected range.

Click the  button on the tool menu or select **[Tools] - [Compress/Decompress]** (**[Alt]**, **[T]**, **[P]**) to open the contraction/extension screen.



**Figure 5-3 Contraction/Extension Screen**

Immediately after deforming a waveform on the contraction/extension screen and returning to the waveform display screen, the status before waveform deformation can be recovered by selecting **[Edit] - [Undo]** (**[Alt]**, **[E]**, **[U]**), or pressing **[Ctrl] + [U]**.  “4.4 Undo and Redo”

### 5.2.1 Contraction/Extension of horizontal axis

Select the range with the markers on the waveform display screen before contracting/extending the horizontal axis.  “4.5.6 Range selection”

The contraction/extension of the horizontal axis is set in the **[X]** area on the contraction/extension screen.

#### a) Using the selected range as the compression/decompression start/end points

Input numerical values in the input areas to the right of **[Start X=]** and **[End X=]** and click the **[OK]** button.

The range selected with the markers in advance can be contracted, extended, or moved to the range selected with the start/end points.

Data immediately before or after is filled in the area where data is removed as a result of contraction/extension.

**b) Extending the selected range to the full size**

Click the **Fit Length** button to extend the range selected with the markers in advance to the whole waveform.

Most of actual data collected with the digital oscilloscope does not exactly consist of one cycle. In such a case, this function can clip one cycle.

**c) Miscellaneous**

Note that the waveform may be distorted when the contraction/extension rate is too high.

**5.2.2 Contraction/extension of vertical axis**

The vertical axis is contracted/extended within the selected range.

Select the range with the markers on the waveform display screen before contracting/extending the vertical axis.  "4.5.6 Range selection"

The contraction/extension of the vertical axis is set in the **[Y]** area on the contraction/extension screen.

**a) Performing contraction/extension by specifying the maximum/minimum values**

When  (option button) at the left of **[ Max/Min]** is selected () , the maximum value of the range selected with the markers is displayed to the right of **[Max]** and the minimum value is displayed to the right of **[Min]**.

Input the maximum/minimum values of the target after contraction/extension in each display section and press the **Enter** key to change the waveform on the waveform display screen. If the waveform is hidden behind the contraction/extension screen and difficult to see, move the screen. The waveform can be vertically inverted by setting a value smaller than the minimum value to the maximum value.

If the desired waveform is gained, click the **OK** button.

To return to the waveform display screen without performing contraction/extension, click the **Cancel** button or press the **Esc** key.

**b) Performing contraction/extension by specifying the amplitude/offset**

When  (option button) at the left of **[ Amp/Offs]** is selected () , the amplitude value of the range selected with the markers is displayed to the right of **[Amplitude]** and the offset value is displayed to the right of **[DC Offset]**.

The following relationship between the amplitude/offset and the maximum/minimum values exist.

$$\text{Amplitude} = (\text{maximum value} - \text{minimum value}), \text{Offset} = \frac{\text{Max. value} + \text{Min. value}}{2}$$

$$\text{Maximum value} = \text{offset} + (\text{amplitude}/2), \text{Minimum value} = \text{offset} - (\text{amplitude}/2)$$

Input the amplitude/offset value of the target after contraction/extension in each display section and click the **OK** button.

## 5.3 Waveform Generation Through Interpolation

The waveform can be vertically inverted by setting a negative value to the amplitude.

### c) Extending the selected range to the maximum amplitude

Click the **Fit Peak-Peak** button to extend the range selected with the markers to the maximum amplitude. If the selected range offset is not 0 before extension, it changes to 0 after extension. Click the **Fit Amplitude** button to extend the positive or negative peak to the maximum value without changing the offset.

### d) Miscellaneous

When the setting results in extension that exceeds the  $\pm$  full scale range, waveforms are clipped at the  $\pm$ full scale range.

Note that the waveform may be distorted when the rate is too high.

## 5.3 Waveform Generation Through Interpolation

The interpolation editing screen is used to create waveforms with different types of interpolation. The “point” set for interpolation is called the “control point”.

Click the  button on the tool menu or select **[Tools] - [Interpolate]** (**[Alt]**, **[T]**, **[I]**) to open the interpolation editing screen.

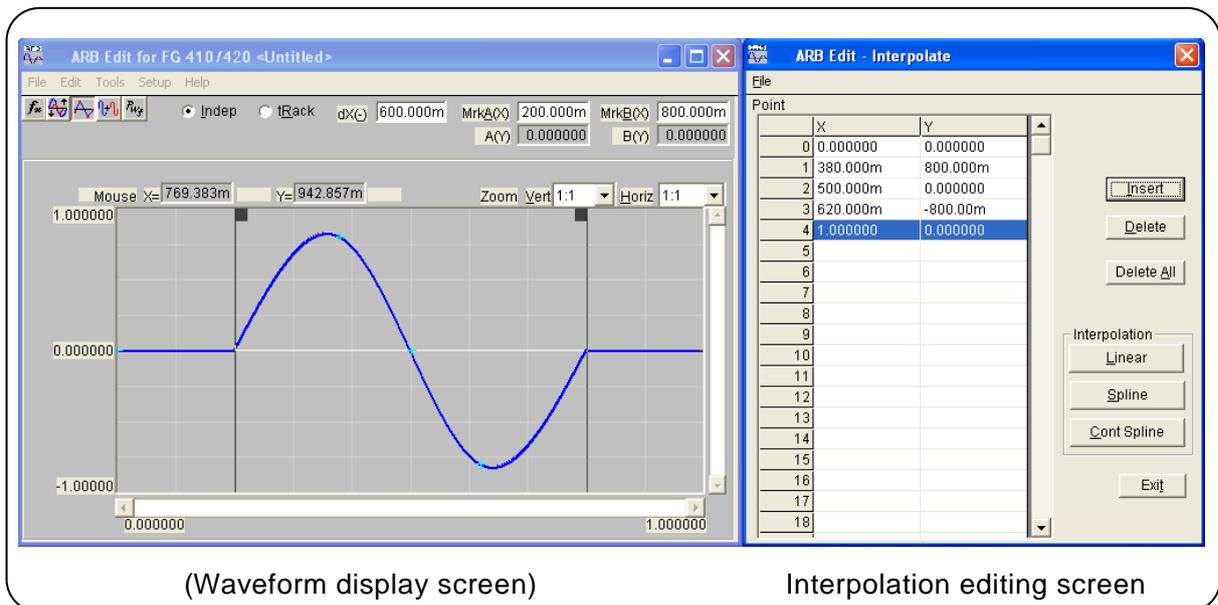


Figure 5-4 Interpolation Editing Screen

Interpolation editing is applied to the selected range. Select the range beforehand on the waveform display screen with markers A and B.

### 5.3.1 Control point setting

Interpolation is applied to the range selected by markers on the waveform display screen.

In the initial state, the following three control points are displayed.

[0.0, 0.0] [0.5, 0.0] [1.0, 0.0]

#### a) Specifying the control point with a numerical value

Click the index cell in the control point list on the interpolation editing screen and then click the **Insert** button to insert and display a new data line. At this time, value X is the intermediate value of the previous and following values, and value Y is 0.0.

Click the X or Y cell and change their respective values. The value X that can be input must be within the range defined by the previous and following control points. Also, X cannot be changed if it is 0 or 1.

Value Y when  $X = 1$  is the same as when  $X = 0$ .

Control points are displayed a **[+]** mark at the specified position in the waveform display area.

#### b) Specifying the control point with mouse

If any of control points' **[+]** marks are shown in red (selected), click an unmarked location of the waveform display area to change all marks to light blue (deselected).

#### c) Moving the control point with mouse

The control point can be moved by dragging the **[+]** mark on the waveform display screen. If the screen magnification ratio is low, it might be difficult to capture the mark due to the display resolution.

When a control point is moved with the mouse, linear interpolation is performed and the waveform display area is overwritten.

#### d) Deleting the control point

Click the **Delete** button to delete the selected control point.

The selected control point cannot be restored. Take care when using this function.

#### e) Deleting all the control points

Click the **Delete All** button to select all the set control points. All the set control points are deleted and the three control points of the initial state are displayed.

The selected control points cannot be restored. Take extra care when using this function.

### 5.3.2 Interpolation

When the range is selected and the control points are set, perform interpolation. The following three types of interpolation methods are possible.

- Linear interpolation where the spaces between control points are interpolated with a straight line
- Spline interpolation where the spaces between control points are interpolated with a smooth curve
- Continuous spline interpolation to use such a curve that the waveform is continued outside to the selected range for interpolation

For linear interpolation, click the **Linear** button or press **Alt + L**.

For spline interpolation, click the **Spline** button or press **Alt + S**.

For continuous spline interpolation, click the **Cont Spline** button or press **Alt + C**.

If part of the waveform is selected as the range, the control points at both edges of the range and those within the range are interpolated.

If the whole waveform is selected, continuous spline interpolates the waveform so that the head and tail of waveform will be smoothly connected if the waveform is repeated. The head and tail would have different values in the case of spline interpolation, so the waveform will not be smooth if repeated.

When the setting results in interpolation that exceeds the  $\pm$  full scale range, waveforms are clipped at the  $\pm$  full scale range.

After interpolation, click the **OK** button to return to the waveform display screen.

Immediately after creating a waveform on the interpolation editing screen and returning to the waveform display screen, the status before waveform creation can be recovered by selecting **Edit** - **Undo** (**Alt**, **E**, **U**), or pressing **Ctrl** + **U**.

### 5.3.3 File operation

The settings on the interpolation editing screen can be saved in a text file.

Select **File** - **Save** (**Alt**, **F**, **S** or **Ctrl** + **S**) on the interpolation editing screen. The screen titled **Save As** appears.

Select a saving location, input a file name and click the **Save** button. File extension is “.prn”, so that it will not be necessary to specify it during file name input.

To read the file containing the interpolation editing screen settings, select **File** - **Open** (**Alt**, **F**, **O** or **Ctrl** + **O**).

When the screen titled **Open** appears, select a file location, input a file name and click the **Open** button.

This file can be read as is using a text editor, spreadsheet software or other application.

Otherwise, **ARB Edit** can read the text file created by using a text editor, spreadsheet software, or other application. When creating a text file, put the X data and Y data on one row.

Other files that can be handled with the **ARB Edit**:  “4.6.1 File types”

## 5.4 Operation Between Waveforms

The inter-waveform operation screen is used to create a wave form by performing arithmetical operations to the waveform in the selected range, standard waveform, numerical expression waveform, or the clipboard waveform.

Click the  button on the tool menu or select **[Tools] - [Operation]** (**[Alt]**, **[T]**, **[O]**) to open the inter-waveform operation screen.

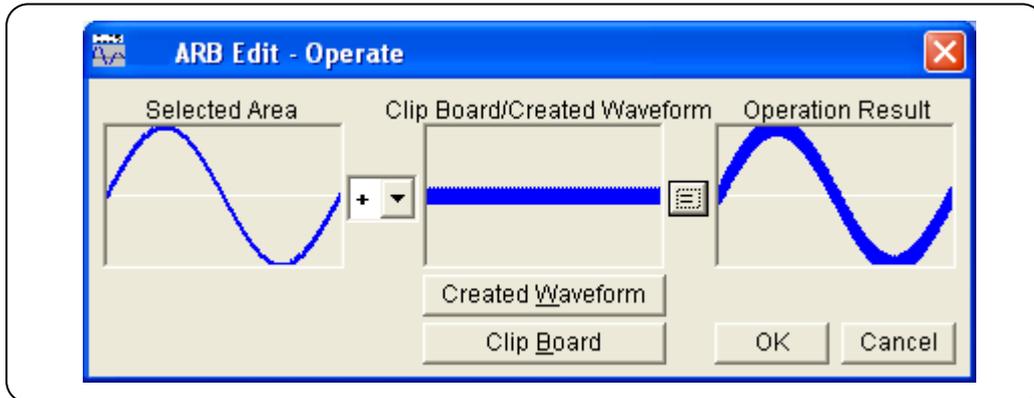


Figure 5-5 Inter-Waveform Operation Screen

Immediately after creating a waveform on the inter-waveform operation screen, the status before waveform creation can be recovered by selecting **[Edit] - [Undo]** (**[Alt]**, **[E]**, **[U]**), or pressing **[Ctrl] + [U]**. Inter-waveform operations are in the selected range. Select the range beforehand on the waveform display screen with markers A and B.

### 5.4.1 Operation types

Clicking the  button to the right of **[+]**, the **+/\***/ arithmetical operations list is displayed.

Select an operator by clicking the item in the list or pressing the , , ,  keys.

Note that **[\*]** indicates multiplication ( $\times$ ) and **[/]** indicates division ( $\div$ ).

### 5.4.2 Object of operation

#### a) Waveform generation

Clicking the **Created Waveform** button or pressing **[Alt] + [W]** displays the waveform generation screen. Note the following restrictions.

- **[Area(X)]** and **[Size]** cannot be changed.
- The range cannot be divided into multiple pages.

Create a waveform referring to “**5.1 Generation of Standard Waveform and Numerical Expression Waveform**” and click the **Page OK** button. The created waveform is displayed in the **[Clip Board/Created Waveform]** area.

### b) Clipboard

Clicking the **Clip Board** button or pressing **Alt** + **B** displays the waveform stored on the clipboard in the **[Clip Board/Created Waveform]** area. Clipboard:  "4.7.2 Clipboard"

If the selected range is longer than the clipboard, the overflowing part of the waveform is treated as zero data.

If the clipboard is longer than the selected range, the first part of the clipboard is used.

Though data on the clipboard are in 16-bit integers (−32768 to +32767), they are converted into the vertical axis unit in the inter-waveform operation. For example, when the vertical axis custom unit is −1 to +1, ±32767 on the clipboard is treated as ±1.

### 5.4.3 Operation execution

Clicking the  button displays the result of inter-waveform operation in **[Operation Result]**.

Click the **OK** button to return to the waveform display screen and reflect the operation result.

Click the **Cancel** button or press the **Esc** key to return to the waveform display screen without performing any operation.

It is recommended to set the vertical axis unit to the custom unit: −1 to +1, especially when executing multiplication in inter-waveform operation.

Under this setting, the result of multiplying ± full scale values can be a ± full scale value.

When the operation result exceeds the ± full scale value, waveforms are clipped at the ± full scale value.

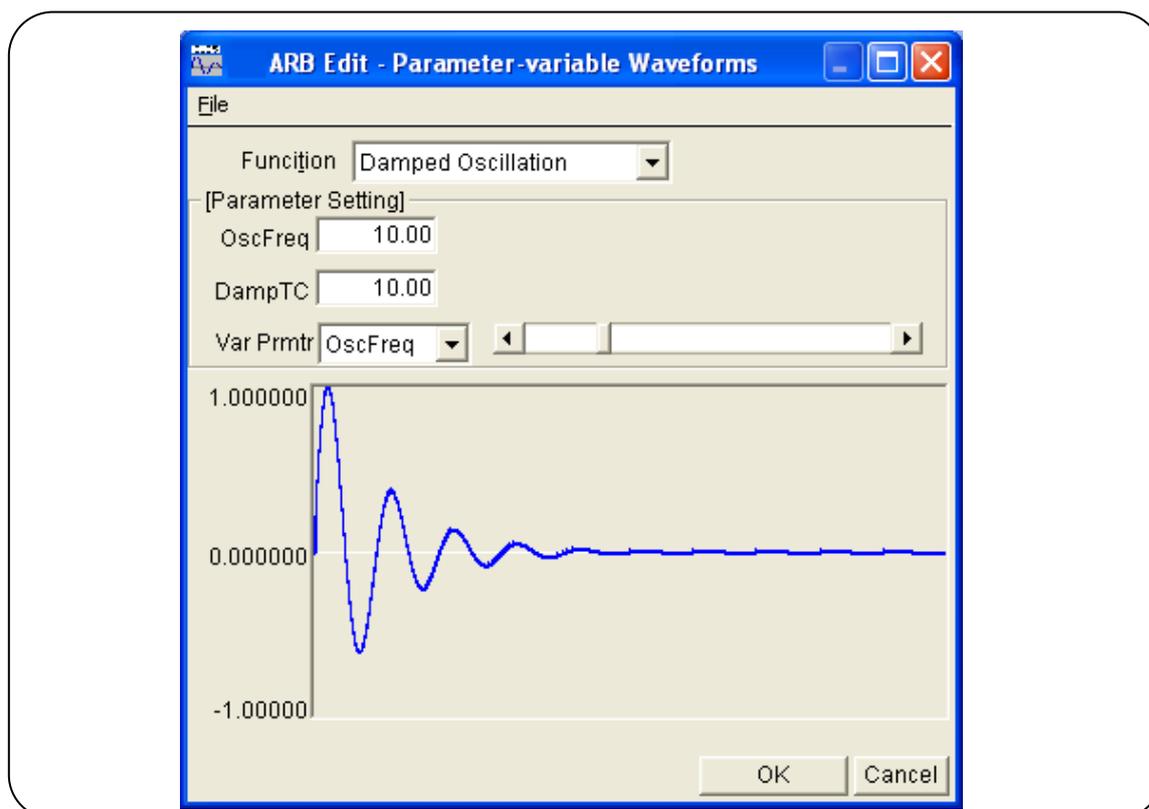
Note that dividing a number by 0 results in infinity and an error usually occurs. To avoid such an error, the result of division by 0 is 0 as an exception in this inter-waveform operation.

## 5.5 PWF (Parameter-Variable Waveform)

In the case of parameter-variable waveforms (PWF), waveform data can easily be generated using 25 types of waveforms and setting up to 5 parameters.

Either click the  button on the toolbar or select **[Tools] - [PWF]** to display the PWF screen.

Once a waveform has been created on the PWF screen and immediately after the waveform display screen has been returned to, the state before the waveform was created can be returned to by selecting **[Edit]-[Undo]** (**[Alt]**, **[E]**, **[U]**) or by pressing **[Ctrl]+[U]**.



**Figure 5-6 PWF Screen**

For details on PWF waveforms, refer to **FG410/FG420 Application Instruction Manual**.

The waveform data that can be generated from the PWF screen includes single-polarity waveforms. On the “ARB Edit” PWF screen, waveform data can be generated in the  $\pm$  full-scale range even for such waveforms. Change the settings of the amplitude range of the oscillator as necessary.

Setting of the amplitude range can also be done in the oscillator settings on the system setting screen.

 “5.6.4 Oscillator Setup”

If, on the PWF screen, the unit settings for the horizontal axis and vertical axis differ from the default values, the settings are forcibly changed to the units of the axes.

### 5.5.1 Waveform selection

Clicking the  button to the right of **[Function]** on the PWF screen lists available waveforms. Select a waveform by clicking it.

The waveform can be also selected by pressing **[Alt] + [T]**, selecting **[Function]** and then selecting the  key/ key ( key/ key).

### 5.5.2 Parameter setting

When a waveform is selected on the PWF screen, the parameters corresponding to the selected waveform are displayed in **[Parameter Setting]**. The number of parameters that can be set differs according to the waveform.

The parameter settings are done through direct numerical input in the text input field to the right of each parameter name. Each time a parameter value is changed, the waveform data is calculated and the display waveform is updated.

Besides numeric input, parameters can be changed via **[Slider]**

Click the  button to the right of **[Var Prmtr]** to display the list of parameters. Select the desired parameter and move **[Slider]** in **[Parameter Setting]** to update the displayed waveform.

Moreover, the parameter setting value is also changed.

### 5.5.3 PWF parameters

The 25 types of waveforms that can be used on the PWF screen, their parameters, and their setting ranges and resolutions are listed below.

**Table 5-5 Steady Sine Group**

Waveform	Parameter	Minimum Value	Maximum Value	Resolution
Unbalanced Sine	Amptd1	-100.00	100.00	0.01
	Amptd2	-100.00	100.00	0.01
Clipped Sine	Clip	0.00	99.99	0.01
CF Ctrl Sine	CF	1.41	10.00	0.01
Angle Ctrl Sine	Angle	-180.00	180.00	0.01
Staircase Sine	Steps	2	100	1
Multi-Cycle Sine	Cycles	0.01	50.00	0.01
	SPhase	-360.00	360.00	0.01

**Table 5-6 Transient Sine Group**

Waveform	Parameter	Minimum Value	Maximum Value	Resolution
On-Ph Ctrl Sine	OnPhase	0.00	360.00	0.01
	SlopeT	0.00	50.00	0.01
Off-Ph Ctrl Sine	OffPhase	0.00	360.00	0.01
	SlopeT	0.00	50.00	0.01
Chattering-On Sine	OnPhase	0.00	360.00	0.01
	ChatterN	0	3	1
	Ton	0.00	20.00	0.01
	Toff	0.00	20.00	0.01
Chattering-Off Sine	OffPhase	0.00	360.00	0.01
	ChatterN	0	3	1
	Ton	0.00	20.00	0.01
	Toff	0.00	20.00	0.01

## 5.5 PWF (Parameter-Variable Waveform)

**Table 5-7 Pulse Group**

Waveform	Parameter	Minimum Value	Maximum Value	Resolution
Gaussian Pulse	Sigma	0.01	100.00	0.01
Lorentz Pulse	Halfwidth	0.01	100.00	0.01
Haversine	Width	0.01	100.00	0.01
Half-Sine Pulse	Width	0.01	100.00	0.01
Trapezoid Pulse	RiseFall	0.01	50.00	0.01
	UpperBase	0.01	100.00	0.01
Sin(x)/x	ZeroCross	1	50	1

**Table 5-8 Transient Response Group**

Waveform	Parameter	Minimum Value	Maximum Value	Resolution
Exponential Rise	TC	0.01	100.00	0.01
Exponential Fall	TC	0.01	100.00	0.01
2nd Ord LPF Step	Fn	1.00	50.00	0.01
	Q	0.50	50.00	0.01
Damped Oscillation	OscFreq	0.01	50.00	0.01
	DampTC	-100.00	100.00	0.01

**Table 5-9 Surge Group**

Waveform	Parameter	Minimum Value	Maximum Value	Resolution
Oscillation Surge	OscFreq	0.01	50.00	0.01
	DampTC	0.01	100.00	0.01
	TrailTC	0.01	100.00	0.01
Pulse Surge	Tr	0.01	100.00	0.01
	Td	0.01	100.00	0.01

**Table 5-10 Others Group**

Waveform	Parameter	Minimum Value	Maximum Value	Resolution
Trapezoid with Offset	Delay	0.00	100.00	0.01
	Rise	0.00	100.00	0.01
	UpperBase	0.00	100.00	0.01
	Fall	0.00	100.00	0.01
	Offset	0.00	100.00	0.01
Half-Sine Edge Pulse	LE	0.00	100.00	0.01
	TE	0.00	100.00	0.01
	Duty	0.00	100.00	0.01
Bottom Referenced Ramp	Symm	0.00	100.00	0.01

### 5.5.4 File operation

The settings on the PWF screen are saved in a text file.

Selecting **[File] - [Save]** (**[Alt]**, **[F]**, **[S]** or **[Ctrl]** + **[S]**) on the PWF screen displays the screen titled **[Save As]**.

Select a saving location, input a file name and click the **[Save]** button. The file extension is “.pwf” and can be omitted at file name input.

To read a file containing the waveform generation screen settings, select **[File] - [Open]** (**[Alt]**, **[F]**, **[O]** or **[Ctrl]** + **[O]**).

When the screen titled **[Open]** appears, select a file location, input a file name and click the **[Open]** button.

Because the file containing the PWF screen settings is a text file, the file can be edited using a text

editor or other application, though this operation is not recommended.

As a result of editing, the file may be not able to be normally read.

Other files that ARB Edit can handle  “4.6.1 File types”

### 5.5.5 Print

The setting conditions for the PWF screen can be also printed out.

Selecting **[File] - [Print]** (**[Alt]**, **[F]**, **[P]** or **[Ctrl]+[P]**) displays the screen titled **[YOKOGAWA ARB Edit - Print]**.

Make settings for the upper, lower and left margins, the printer or font as needed and click the **[OK]** button.

## 5.6 Transferring the Waveform and Settings

The system setting screen is used to set the signal generator model, interface, and serial number. This screen is also used to transfer the signal generator settings or waveform data to the signal generator.

In addition, the vertical/horizontal axis unit displayed on the waveform display screen can be set on this screen.

Select **[Setup] - [Setup]** (**[Alt]**, **[S]**, **[S]**) to open the system setting screen.

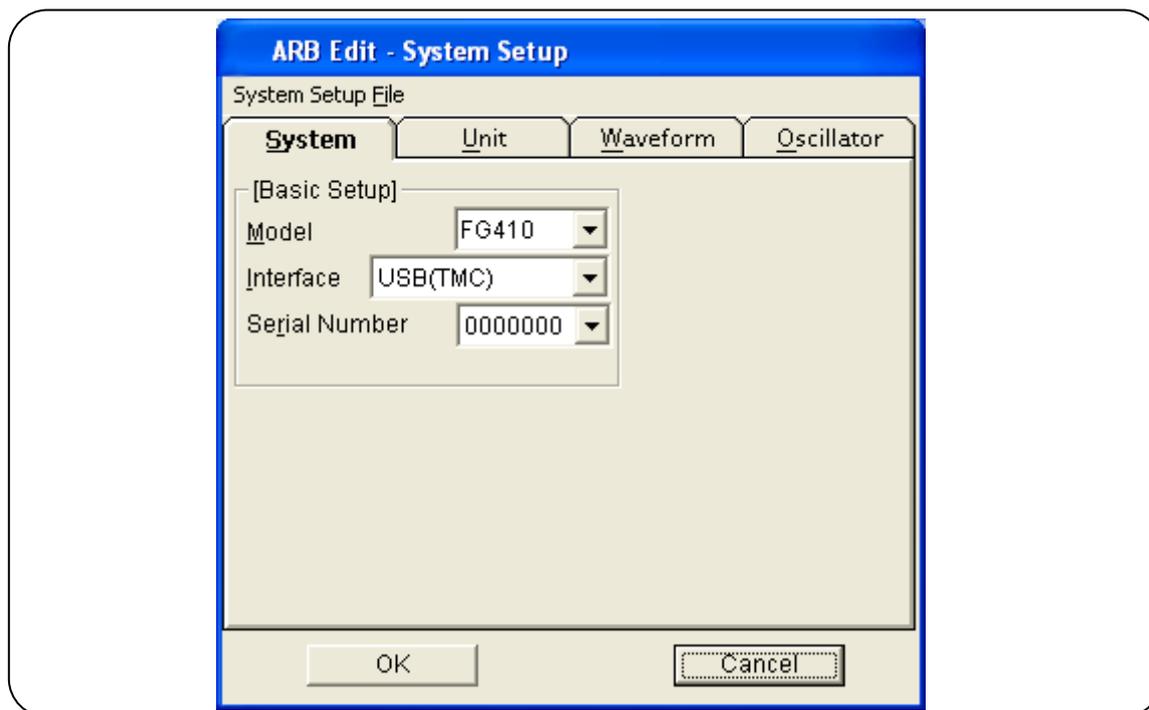


Figure 5-7 System Setup Screen – System Setup

The system setting screen consists of four “tab pages”: **[System]**, **[Unit]**, **[Waveform]**, and **[Oscillator]**.

### 5.6.1 Model setting

The **[Basic Setup]** frame on the **[System]** page is used select the signal generator model and the interface and set the serial number.

#### a) Selecting the target model

Click the  button to the right of **[Model]** to display the list of supported signal generator models. Click one in the list or press the     keys to select a model.

The setting item and settable range in **[Waveform]** and **[Oscillator]** vary depending on the selected model.

The selected model is saved even after the **ARB Edit** is exited and the same setting applies at the next startup.

### b) Interface selection

Click the ▾ button to the right of **[Interface]** to display the list of supported interfaces.

Click one in the list or press the     keys to select an interface.

The selected interface is saved even after the ARB Edit is exited and the same setting applies at the next startup.

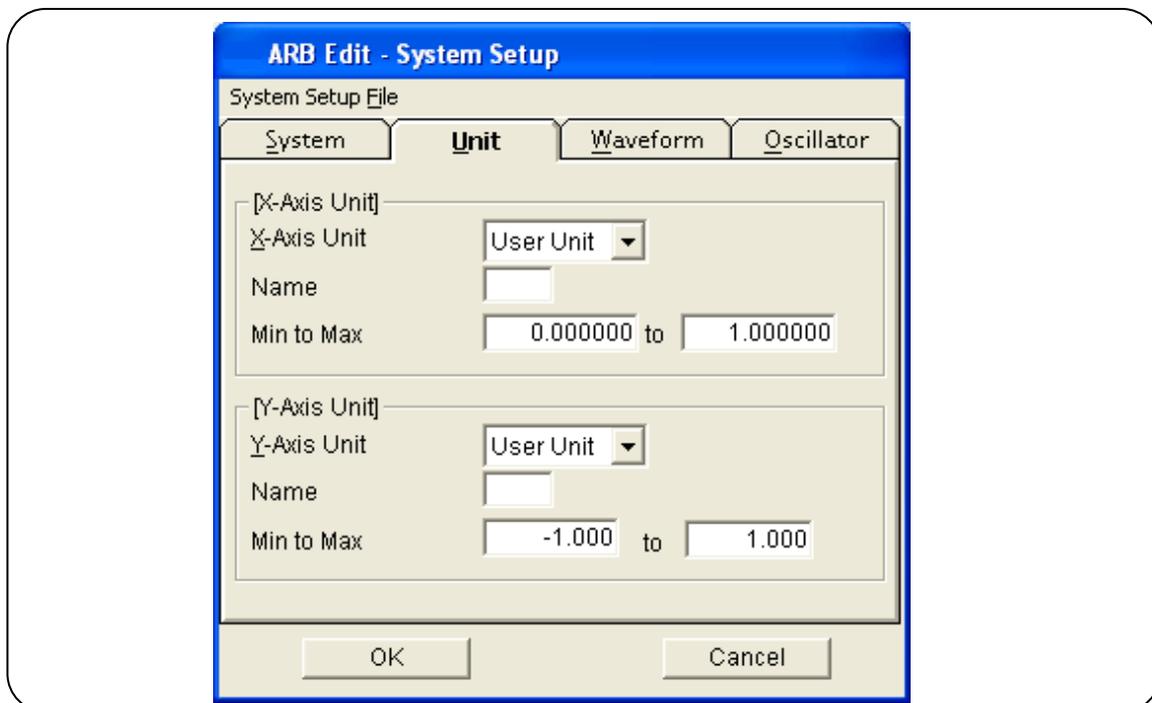
### c) Serial number setting

Click the ▾ button to the right of **[Serial Number]** to display the list of connected signal detector to serial numbers. Click one in the list or press the     keys to select a serial number.

If not a single unit is connected, “None” is displayed and no item other than “None” can be selected.

Check the signal generator to be connected for its serial number.

## 5.6.2 Axis unit setting



**Figure 5-8 System Setup Screen – Unit Setup**

In the **[X Axis Unit]** and **[Y Axis Unit]** fields on the **[Unit]** page, perform the settings of the horizontal axis and vertical axis for waveform display.

On the system setting screen, double-click the **[Unit Setup]** to enable the **[Unit]** page.

#### a) Horizontal axis unit

The time and the user unit can be used as the display/setting unit of the horizontal axis in addition to the waveform data address.

The time is interlocked with **[Frequency]** and **[Period]** in **[Oscillator]**.

From the head to the tail of waveform data, that is, one cycle corresponds to **[Period]** in **[Oscillator]**.

For example, this function is useful when creating a waveform through interpolation by setting the

voltage to the vertical axis and the time to the horizontal axis.

In the custom unit, any values can be set to the beginning and end of waveform data as well as the unit name.

Several examples in the custom unit of the horizontal axis are shown in “Table 5-11 Examples of Custom Units for the Horizontal Axis”.

When a numerical expression is used to generate a waveform, it is useful to use the 0 to 6.283185 radian units because trigonometrical functions such as  $\sin()$  are in radian units.

Click the  button to the right of **[X-Axis Unit]** to display the list of selectable horizontal axis units.

Click one in the list or press the     keys to select a horizontal axis unit.

When the custom unit is selected as a custom unit, **[Name]**, **[Min to Max]** can be set.

Input a string consisting of up to four 1-byte characters as the name of the horizontal axis unit in the area to the right of **[Name]**.

Input numerical values for the minimum value (leftmost value of waveform) and maximum value (rightmost value of waveform) for the custom unit in the areas to the right of **[Min to Max]**.

**Table 5-11 Examples of Custom Units for the Horizontal Axis**

Range	Name (Explanation)
0 to 1	cycle
-1 to 1	(Use this to align with the vertical axis range when the custom unit for the vertical axis is $\pm 1$ .)
0 to 360	degrees ( $^{\circ}$ )
0 to 400	grads
0 to 6.283185	radians

### b) Vertical axis unit

The voltage and the custom unit can be used as the display/setting unit of vertical axis in addition to the waveform data (16 bits:  $-32768$  to  $+32767$ ).

The voltage is interlocked with **[Amplitude]** and **[DC Offset]** in **[Oscillator]**.

For example, this function is useful when creating a waveform through interpolation by setting the voltage to the vertical axis and the time to the horizontal axis.

In the custom unit, any value can be set at the beginning and end of waveform data as well as the unit name.

When a numerical expression is used to generate a waveform, it is useful to use  $-1$  to  $+1$  because the maximum value of trigonometrical functions such as  $\sin()$  is  $\pm 1$ .

Click the  button to the right of **[Y-Axis Unit]** to display the list of selectable vertical axis units.

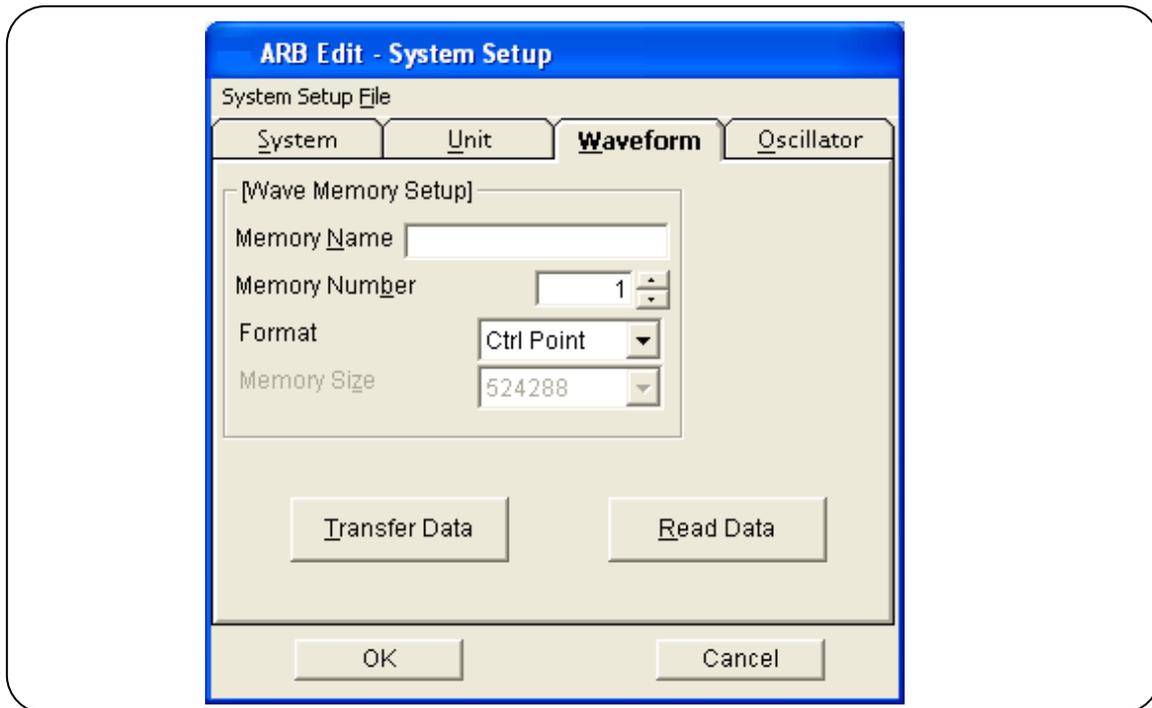
Click one in the list or press the     keys to select a vertical axis unit.

When the custom unit is selected, **[Name]**, **[Min to Max]** can be set.

Input a string consisting of up to four 1-byte characters as the name of the vertical axis unit in the area to the right of **[Name]**.

Input numerical values for the minimum value (lowermost value of waveform) and maximum value (uppermost value of waveform) for the custom unit in the areas to the right of **[Min to Max]**.

### 5.6.3 Waveform memory setting



**Figure 5-9 System Setup Screen – Waveform memory Setup**

The **[Wave Memory Setup]** frame on the **[Waveform]** page is used to set the waveform memory name, waveform memory number, and transfer method. Some signal generator models have items that cannot be set.

#### a) Waveform memory name

Input a waveform memory in the area to the right of **[Memory Name]**.

The waveform memory name can be set with up to 20 one-byte alphanumerical characters.

One-byte katakana and double quotation marks cannot be used.

#### b) Waveform memory number

Click the  button to the right of **[Memory Number]** to select a waveform memory number.

Click  to increase the memory number and click  to decrease the memory number.

It is also possible to directly input a numerical value in the numerical value display area.

#### CAUTION

FG410/FG420 waveform memory

Waveform data cannot be transferred to memory 0.

Memories 1 to 128 are non-volatile memories. The transferred waveform data in these memories is saved even after the power is switched off.

### c) Transfer method

Click the  button to the right of **[Transfer Method]** to display the list of transfer methods that can be selected.

Depending on the waveform data, transfer in the **[Control Point Format]** may not be possible. In this case, the control point format cannot be selected and only **[Array Format]** can be selected.

The control point format is waveform data for generating waveforms through linear interpolation inside the signal generator.

Control point data is created from the waveform data displayed on the waveform display screen when the system setting screen is displayed.

For example, in the case of waveform data that involves complex changes such as noise, the number of valid data points may not suffice. In such a case, the generation of control point format data is stopped and the data is generated in the array format only.

The control point format has the advantage of a smaller amount of data compared to the array format, which fits in the waveform memory of the main unit. Therefore, when using arbitrary waveforms during sequence oscillation of the FG410/FG420, a larger number of waveform types can be used. Note that the control point format data of this transfer method does not necessarily match the control points on the interpolation editing screen.

The array format consists of data strings corresponding to waveform memory addresses. The data of the control point format described previously is created from data in this array format.

### d) Waveform memory size

If **[Array Format]** is selected as the transfer format, **[Memory Size]** becomes selectable. In the case of **[Control Point Format]**, manipulation is not possible.

Click the  button to the right of **[Memory Size]** to display the list of waveform memory sizes that can be selected.

Either click on an item in the list or select a size by pressing the     keys.

When wishing to simply output an arbitrary waveform, a larger size is more convenient, but if wishing to use arbitrary waveform data for sequence oscillation, a larger size limits the arbitrary waveforms that can be used.

### e) Transfer execution

Click the  button or press  +  to transfer the generated waveform data to the signal generator and output that waveform.

---

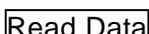
#### CAUTION

---

To output different arbitrary waveforms from **CH1** and **CH2** on the **FG420**, transfer the waveform data to the waveform memory of the different numbers, because the waveform memory is shared between **CH1** and **CH2**.

---

### f) Read execution

Click the  button or press  +  to read waveform data from the main unit. The read waveform data is displayed on the waveform display screen.

If the waveform data that was read from the main unit was control point format data, the control points can be changed on the interpolation editing screen.

5.6.4 Oscillator Setup

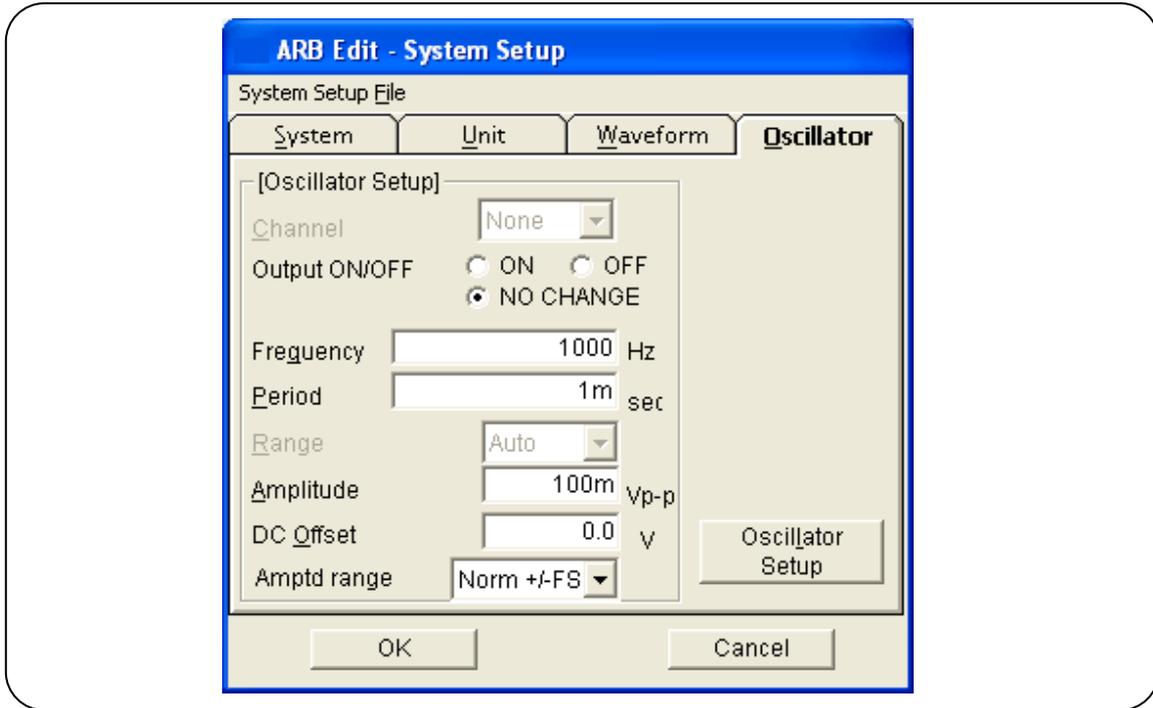


Figure 5-10 System Setup Screen – Oscillator Setup

The [Oscillator Setup] frame in the [Oscillator] page is used to set the signal generator channel, output on/off, frequency (cycle), output range, amplitude, DC offset, and amplitude range.

Click the [Unit] tab on the system setting screen, the [Unit] page is enabled.

The relationship between the signal generator models and settable items is shown in “Table 5-12 Signal Generator Setting”.

Table 5-12 Signal Generator Setting

	FG410	FG420
Channel	–	○
Output on/off		○
Frequency		○
Period		○
Output range		○
Amplitude		○
DC offset		○
Amplitude range		○

## 5.6 Transferring the Waveform and Settings

In the frequency, period, amplitude, and DC offset, T ( $10^{+12}$ ), G ( $10^{+9}$ ), M ( $10^{+6}$ ), k ( $10^{+3}$ ), m ( $10^{-3}$ ), u ( $10^{-6}$ :  $\mu$ ), n ( $10^{-9}$ ), p ( $10^{-12}$ ), f ( $10^{-15}$ ), and a ( $10^{-18}$ ) can be added after the number.

The oscillator setting is initialized after the next startup after **ARB Edit** is exited or an additional ARB Edit is started.

 “5.6.8 Initial values”

### a) Channel

Click the  button to the right of **[Channel]** to display the list of selectable modes.

Click one in the list or press the     keys to select a mode.

### b) Output on/off

Click  (option button) to the left in the  **ON**] or  **OFF**] display in the **[Output ON/OFF]** section to make it selected () to select on or off.

### c) Frequency

Click the input area to the right of **[Frequency]** or press  +  to activate the input area. Input a numerical value in this status and press the  key to determine the value.

Changing the frequency setting also updates the cycle (inverse number of frequency) display.

### d) Period

Click the input area to the right of **[Period]** or press  +  to activate the input area. Input a numerical value in this status and press the  key to determine the value.

Changing the cycle setting also updates the frequency display.

### e) Range

Click the  button to the right of **[Range]** to display the list of selectable output ranges.

Click one in the list or press the     keys to select an output range.

\* In the FG420 and FG420, the setting is fixed to **[Auto]**.

### f) Amplitude

Click the input area to the right of **[Amplitude]** or press  +  to activate the input area. Input a numerical value at this status and press the  key to determine the value.

In addition, the amplitude and DC offset settings put restrictions on each other, with restrictions placed on the range to prevent errors when transfer is executed. The settable range also differs according to the amplitude range setting.

### g) DC offset

Click the input area to the right of **[DC Offset]** or press  +  to activate the input area. Input a numerical value at this status and press the  key to determine the value.

In addition, the amplitude and DC offset settings put restrictions on each other, with restrictions placed on the range to prevent errors when transfer is executed. The settable range also differs according to the amplitude range setting.

### h) Amplitude range

Click the  button to the right of [**A**mplitude range] to display the list of amplitude ranges that can be selected.

Select the output range by clicking on an item in the list or pressing the     keys.

If [**N**orm  $\pm$ FS] or [**I**nv  $\pm$ FS] is selected as the amplitude range, the [**A**mplitude] setting unit is [**V**p-p]. In all other cases, the [**A**mplitude] setting unit is [**V**pk].

### i) Transferring data

Clicking the  button or pressing  +  transfers the settings in the [**O**scillator **S**etup] frame to the signal generator.

---

### ⚠ CAUTION

---

If amplitude parameter settings for the FG410 or FG420 are performed with [**A**RB **E**dit], the following items are forcibly switched.

- Amplitude mode In the case of sequence oscillation only, continuous oscillation is set.
  - Load impedance setting Open (Hi-Z)
- 

## 5.6.5 Cautions during transfer and reading

When performing waveform data transfer, read, or oscillator settings of the main parameters among the oscillator settings, observe the following cautions.

- Data cannot be transferred unless the driver software is installed normally.  
 “2.2.1 Installing the USB driver software”
- Do not perform any operation using the **ARB Edit** during data transfer.
- Even when multiple **ARB Edits** are running, it is not possible to transfer data from multiple **ARB Edits** at the same time.

## 5.6.6 File operations

The settings for the system setting screen are saved to a file or read from a file.

The system setting file for the **ARB Edit** is a binary file in the unique format and cannot be used in other applications.

Select [**S**ystem **S**etup **F**ile] - [**S**ave] (   or  + ) on the system setting screen to display the screen titled [**S**ave **A**s].

Select a saving location, input a file name and click the  button. The file extension is “.ocb” and can be omitted at file name input.

To read the system setting file, select [**S**ystem **S**etup **F**ile] - [**O**pen] (   or  + )

When the screen titled [**O**pen **F**ile] appears, select a file location, input a file name and click the  button. Other files that can be handled with the **ARB Edit**:  “4.6.1 File types”

### 5.6.7 Print

The setting conditions for the system setting screen can also be printed out.

Select [**System Setup File**] - [**Print**] (**Alt**, **F**, **P** or **Ctrl**+**P**) to display the screen titled [**YOKOGAWA ARB Edit - Print**].

Make settings for the upper, lower and left margins, the printer or font as needed and click the **OK** button.

### 5.6.8 Initial values

The parameters set on the system screen and initialized when the **ARB Edit** is started are shown in “Table 5-13 Initialized Values”.

**Table 5-13 Initialized Values**

	FG410	FG420
Waveform memory name	(No specification)	
Waveform memory number	0	
Channel	–	1
Output on/off	OFF	
Frequency [Hz]	1000	
Period [sec]	1m	
Output range	Auto	
Amplitude [Vp-p]	0.1	
DC offset [V]	0.0	
Amplitude range	Norm +/-FS	
X axis unit	Custom	
X axis name	(No specification)	
X axis minimum value	0.000000	
X axis maximum value	1.000000	
Y axis unit	Custom	
Y axis name	(No specification)	
Y axis minimum value	–1.000	
Y axis maximum value	1.000	

## 6. ERROR MESSAGES

6.1	Arbitrary Wave Edit Software Error .....	6-2
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## 6.1 Arbitrary Wave Edit Software Error

The following table summarizes the error specifications of the **Arbitrary Waveform Editor**.

**Table 6-1 Error Messages**

Message	Description
Memory Allocation Failed.	Memory for OS operation could not be secured at startup.
No Spline point.	During waveform generation using interpolation, the interpolation was performed without any control points specified.
Cannot create two spline point on same X. Do you want continue?	Displayed when the leftmost and rightmost values of the Y axis are different when generating a waveform using interpolation.
File Write error.	An error occurred while a file was being saved in “ARB Edit”. If this error persists, restart the “ARB Edit”.
File Read error	An error occurred while a file was being read in the “ARB Edit”. Do not use this file.
Read in is interrupted because the data file contains data of a model that is not supported.	An error occurred because a data file containing the information of a model other than the FG410/FG420 was read. Do not use this file.
Clip Board Open error.	An error occurred during an inter-waveform operation executed for the clipboard. If this error persists, restart the “ARB Edit”.
Clip Board Read error.	
Clip Board Write error.	
Clip Board error.	
Constant format error.	An arbitrary function expression for waveform generation contains an error. Modify the error cause according to the message.
Syntax error in equation.	
Lack of parenthesis.	
Unbalance of parenthesis.	
Divided by 0.	
Compile error.	
The unit of the axis was changed.	Indicates that the axis setting is other than the initial state, when the PWF screen is displayed.
The axis range was set to X[0.0 - 1.0], Y[-1.0 - 1.0].	
Illegal Font Size.	Modify the specified font size in the printing dialog box.
No Listeners on the INTERFACE.	This error occurs when waveform data transfer, read, or oscillator settings are performed with no signal generator connected via USB.
The Sequence Edit Software is running. Terminate the Sequence Edit Software and restart.	After terminating the <b>Sequence Edit Software</b> , start the <b>Arbitrary Waveform Editor</b> .
Transfer is interrupted because an error occurred.	If the “-225, ‘Out of memory’” message is displayed immediately before this message, check the total size of the FG410/FG420 arbitrary waveform data and delete any unnecessary data. If such a message is not displayed, switch off the power of the FG410/FG410 once before operating again.

## 7. MAINTENANCE

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7.2	Replacement of Damaged CD-ROM.....	7-2
7.3	Version Check .....	7-2

### 7.1 Handling CD-ROM

Handle the CD-ROM carefully as described below.

- Store the CD-ROM in a place without direct sunlight, high temperature, and high humidity.
- Use and store the CD-ROM in a place without dust.
- Do not touch the recording surface directly. It may cause damage or errors.
- If it is dirty, wipe it with a soft dry cloth. Do not use any solvent such as benzene.
- Store the CD-ROM in a vertical or horizontal position so that it would not be deformed.
- When writing on the label surface of the CD-ROM, use a felt-tipped pen (Do not use anything with a hard point such as a ball point pen or pencil.)

### 7.2 Replacement of Damaged CD-ROM

If the Arbitrary Wave Edit Software CD-ROM is damaged, contact Yokogawa Test & Measurement Corporation or your local distributor.

We will replace it with a new CD-ROM at cost.

### 7.3 Version Check

The Arbitrary Wave Edit Software version number is displayed on the CD-ROM.

The version can be displayed by selecting **[Help] - [About]**.

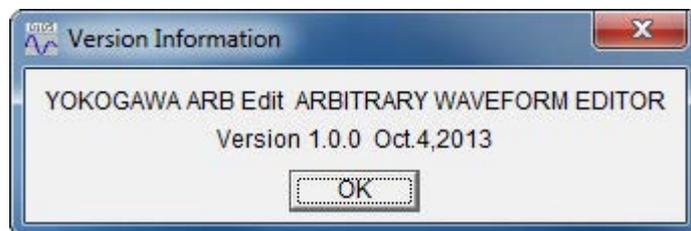


Figure 7-1 Version Dialog Box



## Revision

April 2014	1st Edition
December 2015	2nd Edition
October 2017	3rd Edition

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### **IMPORTANT**

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1. Reproduction of the program or this instruction manual either in part or in whole, is strictly prohibited.
2. The contents of this instruction manual are subject to change without notice.
3. Although great care has been taken to ensure the accuracy and completeness of the information contained in this user's manual, please notify Yokogawa Test & Measurement Corporation or an Yokogawa Test & Measurement Corporation sales representative in case any unclear points, errors, or omissions are found.
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FG410/FG420 ARBITRARY WAVEFORM EDITOR User's Manual

**Yokogawa Test & Measurement Corporation**

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