ARBITRARY WAVEFORM EDITOR

DF0106

INSTRUCTION MANUAL

NF Corporation

DA00057941-002

ARBITRARY WAVEFORM EDITOR

DF0106

INSTRUCTION MANUAL

About Trademarks

Preface

Thank you for purchasing our "DF1906 Digital Function Generator". "DF0106 Arbitrary Waveform Editor" is an application designed for the DF1906.

● Before Reading the Instruction Manual

This instruction manual (PDF file) is included in the CD-ROM (file name: DF0106_InstructionManual.pdf).

This instruction manual is intended for users with knowledge of the basic operation of Microsoft Windows OS (Windows 7 [32-bit or 64-bit]/ Windows 8.1 [32-bit or 64-bit]/ Windows 10 [32-bit or 64-bit]). For more information on Windows basic operation and terms such as "click" and "drag," refer to a Windows user's guide, etc.

The figures and messages shown in this instruction manual are those for Windows 7. The display content may differ in other OS environments.

When you want to transfer waveform data, etc. created by "DF0106 Arbitrary Waveform Editor" to the signal generator, install the driver software compatible with your interface while referring to "2. Installation." If you want to use a USB interface, you need a PC with a USB interface.

First, read "1. Overview" and then install DF0106 according to the instructions in "2. Installation."

If you are a first-time user, perform the operation according to "3. For First-time Users."

● This manual consists of the following chapters

1. **Overview**
   Describes an overview of the functions of DF0106.
2. **Installation**
   Describes the environment necessary to operate DF0106 and the installation procedure.
3. **For First-Time Users**
   Describes the operation of DF0106 using a simple example for each main function.
   Please read this chapter while performing the operation.
4. **Operation on Waveform Display Screen**
   Describes the functions on the waveform display screen and how to operate them.
5. **Operation on Other Screens**
   Describes the functions on the other screens and how to operate them.

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1. Overview

1.1 Overview

" DF0106 Arbitrary Waveform Editor" is an application that allows users to generate and edit arbitrary waveforms and transfer them to NF's signal generator with an arbitrary waveform generation function.
" DF0106 Arbitrary Waveform Editor" runs in Windows on a PC and transfers waveforms and other data via USB.

The main functions of "DF0106 Arbitrary Waveform Editor" are as follows.

[Waveform Generation Function]

- Generates standard waveforms in the specified range.
- Generates arbitrary waveforms using mathematical expression in the specified range.
- Generates an arbitrary waveform by a linear or spline interpolation by specifying control points.

[Waveform Editing Function]

- Allows users to edit the waveform using the copy, cut, and paste functions.
- Allows users to compress/expand the waveform vertically/horizontally.
- Allows users to apply the four arithmetic operations to the standard waveform and waveform data in the clipboard in the specified range.

[Transfer Function]

- Allows users to transfer the waveform data and the main parameter settings of the signal generator via USB.

[Display Function]

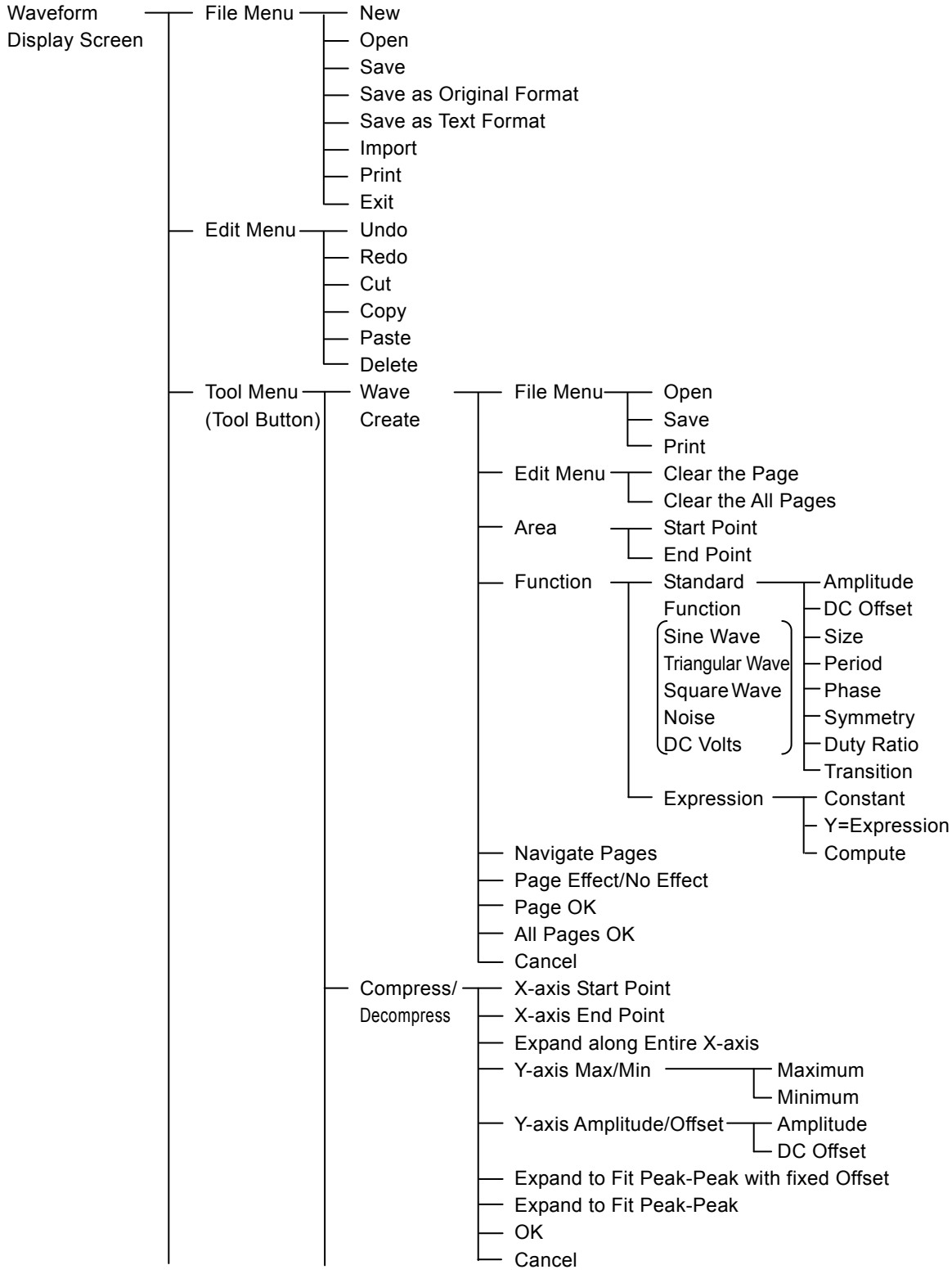
- Allows users to display and edit waveforms in the digital pattern, in addition to the normal waveform display.
- Allows users to specify the range using two markers or read the waveform values.

[File Manipulation Function]

- Allows users to save and read the waveform data, signal generator settings, mathematical expressions for waveform , interpolation control points, etc.

1.2 Function Tree

The function tree of "DF0106 Arbitrary Waveform Editor" is shown on the following pages.



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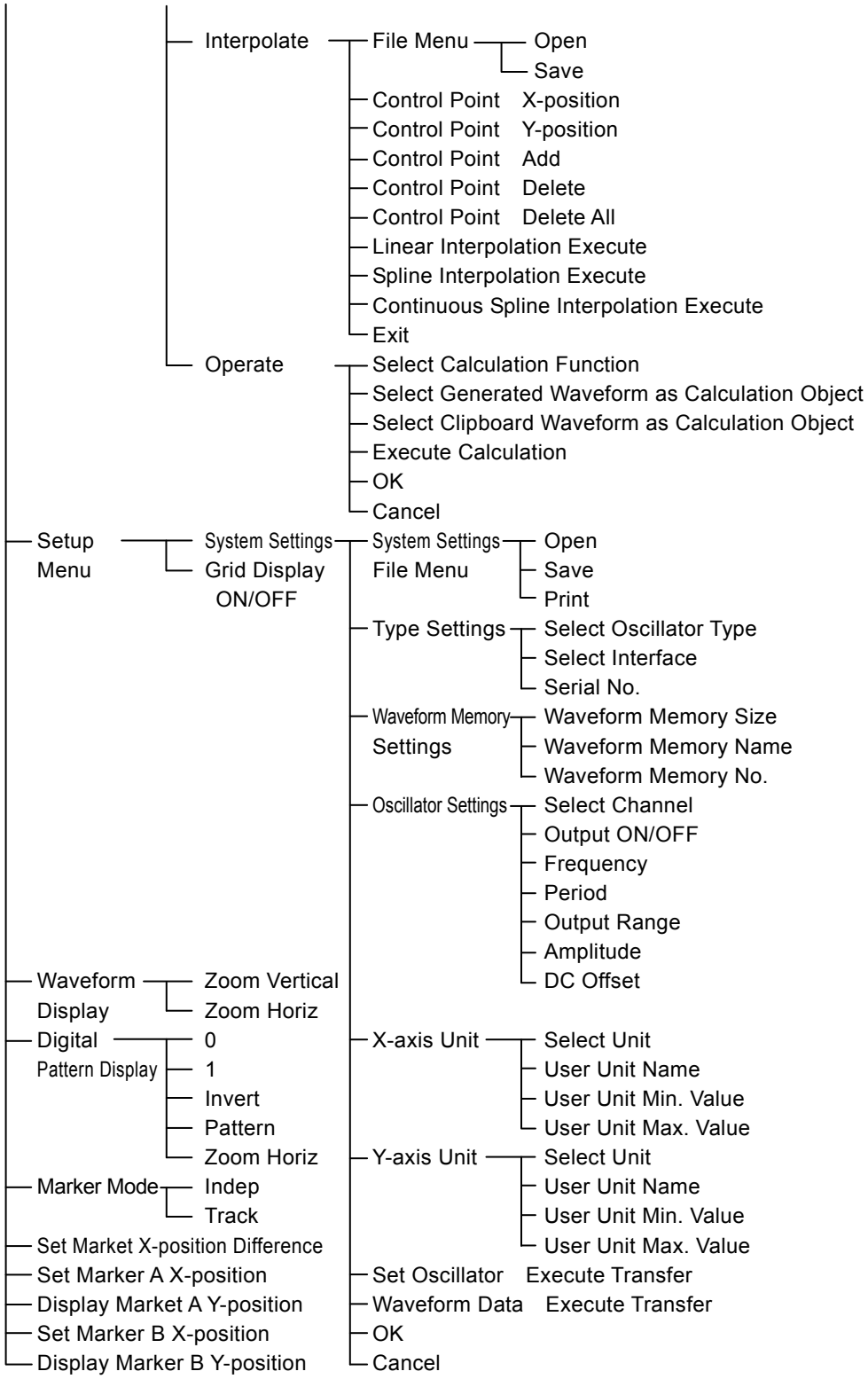


2. Installation

2.1 Hardware Requirements

Before you install "DF0106 Arbitrary Waveform Editor", check that the system satisfies the following conditions.

2.1.1 Personal Computer

- Microsoft Windows 7 (32-bit/64-bit)/ Microsoft Windows 8.1 (32-bit/64-bit)/ Microsoft Windows 10 (32-bit/64-bit)
- PC running one of the above Windows versions.
- CPU that meets the recommended conditions of your OS environment
- Memory that has the capacity to meet the recommended conditions of your OS environment at least 8 MB of free memory is required to start DF0106.
- Disk that meets the recommended conditions of your OS environment at least 10 MB of free disk space is required to start DF0106. More free space is required to store waveforms and other data.
- CD-ROM drive
- Color display with 800 x 600 pixels or higher
- Mouse (or another pointing device) that works normally with the OS.
- USB

2.2 Installation Procedures

To install/uninstall "DF0106 Arbitrary Waveform Editor", log on to Windows with administrator permissions.

To establish the communication connection between "DF0106 Arbitrary Waveform Editor" and the "DF1906 Digital Function Generator", the USB driver software must be installed. If the VISA environment is set up in your computer, the USB driver software is already installed.

VISA (Virtual Instrument Software Architecture) is a standard recommended by the IVI Foundation to promote the standardization of instrument software architecture.

2.2.1 Installing USB Driver Software

"DF0106 Arbitrary Waveform Editor" is confirmed to work on NI-VISA Version 16.0 provided by National Instruments Corporation. Please be aware that we do not provide support for problems that occur in the VISA environment provided by other vendor products.
If you want to use "DF0106 Arbitrary Waveform Editor" in the NI-VISA environment, you must obtain the license yourself from National Instruments Corporation. For details of NI-VISA, contact National Instruments Corporation or visit the National Instruments Website.

2.2.2 Installing DF0106

a) Insert the CD-ROM containing "DF1906 Instruction Manual" into the CD-ROM drive of the PC.

b) Double-click [¥English¥Application¥DF0106¥setup.exe] on the CD-ROM.
Run D:\English\Application\DF0106\setup.exe from [Run] in the Start Menu.
"D:" indicates the CD-ROM drive. If your CD-ROM drive is assigned a different drive letter, replace D with the appropriate letter.

c) When the installation is complete, DF0106 can be run.
Click Start – [Programs] – [DF0106] to run DF0106.

2.2.3 Uninstalling DF0106

To remove DF0106, double-click [Programs and Features] in Control Panel, then click DF0106, and then click the [Change/Remove] button. The folder where DF0106 was installed is not necessarily always removed. Files created in the folder will be kept. If you do not need the folder after the uninstall process is complete, delete it.

2.2.4 Installing Sample Files

Examples described in the instruction manual and other waveform examples can be installed with the following steps.

a) Insert the CD-ROM containing "DF0106 Arbitrary Waveform Editor" into the CD-ROM drive of the PC.

b) Copy the ¥English¥Application¥DF0106¥SAMPLES folder on the CD-ROM and all its contents to an appropriate folder on the hard disk.

d) When the installation is complete, the sample files can be read from DF0106.
For more information on the file names and content, refer to README.TXT in the SAMPLES folder.

3. For First-Time Users

3.1 Overview

This chapter describes some examples to demonstrate the basic operation and functions of DF0106 Arbitrary Waveform Editor.

Please read this chapter while actually performing the operation.

This chapter uses the following notation rules.

- A menu name displayed on the screen, string entered by the user, etc. are expressed in sans-serif font and enclosed in brackets [ ].

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

- A button name displayed on the screen, key operated by the user, etc. are expressed in sans-serif font and enclosed in XXX.

  Examples: Cancel, OK, Alt

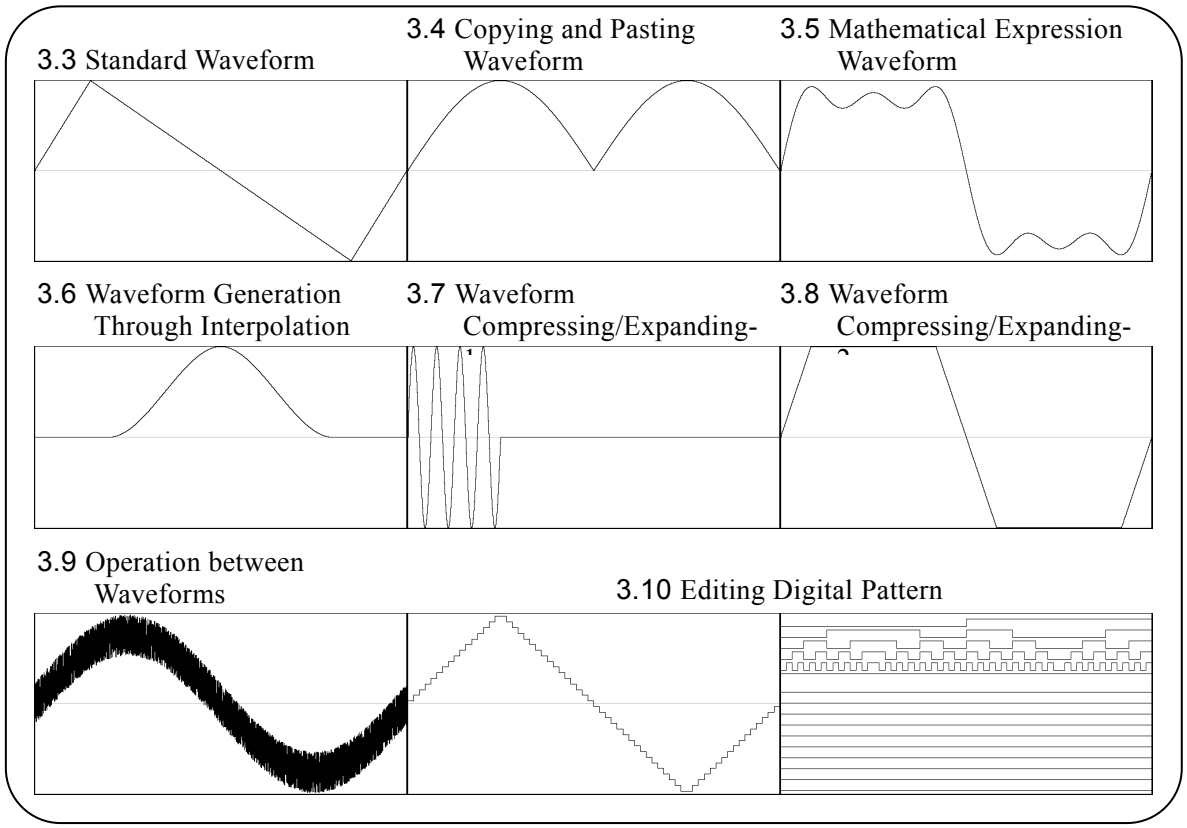


Figure 3-1 Waveform Examples Explained in This Chapter

3.2 Starting and Exiting DF0106

Click Start – [Programs] – [DF0106] to start DF0106.
To exit, click the ✕ mark (close box) on the top right corner, or click [File] – [Exit]. The confirmation message [Exit Program. Are you sure?] will appear. Click the Yes button.

The following examples describe the operation starting from the default state at the start of DF0106. When performing the operation of each example, exit DF0106 and then restart it before performing the operation.

3.3 Standard Waveform

Create a triangular wave with 30% symmetry as an example of standard waveforms.

Step 1: Click the f_w button in the upper left part of the screen. The result is the same as the result of the operation: [Tools] – [Wave Create].
A screen titled [DF0106-Waveform Create] appears.

Step 2: Click the ▼ button on the right of [Function], and then click [Triangle] in the list.

Step 3: Change the value in the number input field on the right of [Symmetry] from [50] to [30], and then press the Enter key. A triangular wave with 30% symmetry was specified.

Step 4: Click All Pages OK to close the waveform generation screen and return to the waveform display screen.

Explanation 1: In this example, waveforms are generated in the entire range of the memory size.
In DF0106, you can divide the waveforms into multiple pages; for example, you can specify the front one-fourth of the waveforms on page 1 and the last half thereof on page 2. ➡ "5.1.1 Range settings and pages"
At this point, click the All Pages OK button to run the specified waveform on the multiple active pages together.
When you want to run the waveform only on the displayed page, click the Page OK button.
Only page 1 is specified in the above example, so clicking any of the buttons produces the same result.

Explanation 2: In addition to the triangular wave, you can select the sine wave, square wave (duty ratio variable), noise, DC, and waveform definition (function) by mathematical expression.
Mathematical expression waveform Example

➡ "3.5 Mathematical Expression Waveform"

3.4 Copying and Pasting Waveform

Create a full wave rectified waveform as an example of the waveform copy and paste function.

Step 1: Click the button in the upper left part of the screen. The result is the same as the result of the operation: [Tools]–[Wave Create].

Step 2: The sine wave is selected by default, so click the All Pages OK button to return to the waveform display screen.

Step 3: Move marker B to the center of the waveform.
When the memory size is 4 KW, [4096.000Word] is displayed in the lower right part of the screen.
Set [2048] (half the memory size) in the number field on the right of [MrkB(X)], and then press the Enter key.

Step 4: Press the C key while holding down the Ctrl key. The result is the same as the result of the operation: [Edit] – [Copy]. The range between markers A and B (data in the former half of the waveform) has been copied to the clipboard.

Step 5: Click ○ (option button) on the left of [○ tRack] to create ◉ (selected state) and switch the marker to the link mode.
Set [2048] in the number field on the right of [MrkA(X)], and then press the Enter key.

Step 6: Click the V key while holding down the Ctrl key. The result is the same as the result of the operation: [Edit] – [Paste].
The waveform data in the clipboard has been pasted to the latter half of the waveform.

Explanation 1: Hereinafter, the operation of pressing the C key while holding down the Ctrl key is referred to as Ctrl + C.
Ctrl + C (Copy) leaves the waveform in the copied area behind in the area.
Ctrl + X (Cut) is the same as Copy which places the data in the selected area into the clipboard, except that the waveform in the selected area is deleted.
Ctrl + D (Delete) deletes the waveform in the selected area, but the content in the clipboard remains unchanged.

Explanation 2: Markers A and B are used to select the range.
If the range specified by the markers is, for example, 0 to 2048, the actual selected range is 0 <= X < 2048.

Explanation 3: About Clipboard ➡ "4.8.2 Clipboard", Windows manual

3.5 Mathematical Expression Waveform

Create a waveform by superimposing the third and fifth harmonics on a fundamental wave as an example of generating a waveform by mathematical expression.

Step 1: Click [Setup] – [Setup].
A screen titled [DF0106-System Setup] appears.

Step 2: Click the page tab titled [Unit Setup].

Step 3: Click the button on the right of [X-Axis Unit] and then click [User Unit] in the displayed list.
Leave the default value [0.000000 to 1.000000] in Min. to Max. Value two lines below the current line as is.

Step 4: Click the button on the right of [Y-Axis Unit] and then click [User Unit] in the displayed list.
Leave the default value [-1.000 to 1.000] in Min. to Max. Value on the bottom line as is.

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

Step 6: Click the button in the upper left part of the screen.

Step 7: Click the button on the right of [Function] and then click [Expression] in the displayed list.

Step 8: Enter [s=2*pi;] in the input field on the right of [Constant].
Enter [sin(x*s)+sin(x*s*3)/3+sin(x*s*5)/5] in the input field on the right of [Y=].

Step 9: Click the Compute button to display the calculated waveform on the waveform generation screen.

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

Explanation 1: In the above example, the entire range in the X-axis is handled as 0 to 1 by using the user unit.
Likewise, the entire range in the Y-axis is ±1.
The constant is specified as s=2π, and use of [x*s] in the expression makes it easy to represent one sine-wave period.

Explanation 2: If you specify 0 to 6.283185 (2π) for the X-range of the user unit in Step 3, the expression becomes simpler as follows.

[sin(x)+sin(x*3)/3+sin(x*5)/5]

3.6 Waveform Generation Through Interpolation

Create a smooth pulse waveform as an example of generating a waveform by interpolation.

Step 1: Click [Setup] – [Setup] to display a dialog box titled [DF0106-System Setup]. Click the page tab titled [Unit Setup].

Step 2: Click the button on the right of [X-Axis Unit] and then click [User Unit] in the displayed list.
Leave the default value [0.000000 to 1.000000] in Min. to Max. Value two lines below the current line as is. Step 4: Click the button on the right of [Y-Axis Unit] and then click [User Unit] in the displayed list. Leave the default value [-1.000000 to 1.000000] in Min. to Max. Value two lines below the current line as is.
Click the OK button to return to the waveform display screen.

Step 3: Set [0.2] in the number field on the right of [MrkA(X)], and then press the Enter key.
Set [0.8] in the number field on the right of [MrkB(X)], and then press the Enter key.

Step 4: Click the button in the upper left part of the screen. The result is the same as the result of the operation: [Tools] – [Interpolate].
A screen titled [DF0106-Interpolate] appears.

Step 5: Enter [0.5] in the numeric value field on the right of [X=] and [1] in the numeric value field on the right of [Y=], and then click the Add button.

Step 6: Click the Cont Spline button.
An interpolated waveform is displayed on the waveform display screen.
If the waveform is hidden by the interpolation editing screen, move the screen to make it easier to see the waveform.

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

Explanation 1: A point as specified in Step 5 for editing the interpolation is called a "control point."

Explanation 2: A linear interpolation is used to create a waveform by linearly interpolating between the control points.
A spline interpolation is used to smoothly interpolate between the controls points with a spline curve.

Explanation 3: A continuous spline interpolation is used to perform interpolation to smoothly connect the selected range to the previous and subsequent ranges.
When the entire range is selected and the waveform is repeated, it is used to perform interpolation to smoothly connect the waveform to the previous and subsequent waveforms.

3.7 Waveform Compressing/Expanding-1

Create a burst waveform in the first one-fourth of the waveform display screen by compressing a sine wave as an example of compressing/expanding a waveform in the horizontal direction.

Step 1: Click the  button in the upper left part of the screen.
The sine wave is selected by default.
Change the numeric value on the right of [Period] from [1] to [4] to create a sine wave of four periods.
Click the All Pages OK button to return to the waveform display screen.

Step 2: Click the  button in the upper left part of the screen. The result is the same as the result of the operation: [Tools] – [Compress/Decompress].
A screen titled [DF0106-Compress/Decompress] appears.

Step 3: When the memory size is 4 KW, [4096.000Word] is displayed in the lower right part of the screen.
Leave [0] in the number field on the right of [Start X=] as is.
Set [1024] (one-fourth of the memory size) in the number field on the right of [End X=], and then press the Enter key.
Four sine waves on the entire waveform screen are compressed and displayed in the first one-fourth of the waveform display screen.
If the waveform is hidden by the compress/expand screen, move the screen to make it easier to see the waveform.

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

Explanation 1: In this example, [0] in [Start X=] is left as is, so the original waveform is compressed to the first one-fourth of the waveform on the waveform display screen.
For example, in the case of [Start X=][1024] and [End X=][2048], the original waveform is compressed to half of the waveform screen instead of the first one-fourth thereof.

Explanation 2: The specified section of the waveform can be expanded to the entire waveform.
Select a section of the waveform using markers A and B on the waveform display screen in advance.
Click the Fit Length button on the compress/expand screen to expand the selected range to the entire waveform.

3.8 Waveform Compressing/Expanding-2

Create a trapezoidal wave by expanding a triangular wave and clipping it as an example of compressing/expanding a waveform in the vertical direction.

Step 1: Click the button in the upper left part of the screen.
The sine wave is selected by default.

Step 2: Click the button on the right of [Function], and then click [Triangle] in the displayed list.
Click the All Pages OK button to return to the waveform display screen.

Step 2: Click the button in the upper left part of the screen. The result is the same as the result of the operation: [Tools] – [Compress/Decompress].
A screen titled [DF0106-Comress/Decompress] appears.

Step 3: Change [32767] to [100000] in the number field on the right of [Max], and then press the Enter key.
Change [-32767] to [-100000] in the number field on the right of [Min], and then press the Enter key.
On the waveform display screen, a trapezoidal wave is created by expanding a triangular wave vertically and clipping it.
If the waveform is hidden by the compress/expand screen, move the screen to make it easier to see the waveform.

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

Explanation 1: The waveform can also be vertically compressed or moved up and down by the maximum and minimum numeric values specified in Step 3.
If expansion or movement results in exceeding the ± full scale, the waveform is clipped at the ± full scale.

Explanation 2: A section of the waveform can be compressed or expanded by selecting the section of the waveform using markers A and B on the waveform display screen in advance.

Explanation 3: When the waveform does not reach the ± full scale, the waveform can be expanded along the maximum amplitude by clicking the Fit Amplitude button or by clicking the Fit Peak-Peak button.

Explanation 4: When you set [-100000] in Max. and [100000] in Min. in Step 3, the waveform is inverted upside down.

Explanation 5: In this example, the compression/expansion ratio was specified in [Max/Min], but it can also be specified in [Amp/Offs].
Click ○ (option button) on the left of [○ Amp/Offs] to select the option (◉ selected state). Set [200000] in [Amplitude] and [0] in [DC Offset] to obtain the same result as that in this example.

Explanation 6: In this example, a trapezoidal wave was created by clipping a triangular wave, and a trapezoidal wave can be more easily created by setting [Transition] for a square wave.

3.9 Operation between Waveforms

Create a waveform by superimposing noise on a sine wave as an example of operation between waveforms.

Step 1: Click the button in the upper left part of the screen.
The sine wave is selected by default.
Change the numeric value on the right of [Amplitude] from [65534] to [50000] to reduce the amplitude a little.
Click the All Pages OK button to return to the waveform display screen.

Step 2: Click the button in the upper left part of the screen. The result is the same as the result of the operation: [Tools] – [Operate].
A screen titled [DF0106-Operate] appears.

Step 3: Click the Created Waveform button in the middle of the Operation screen.
A screen titled [DF0106-Waveform Create] appears in the same way as clicking the button.

Step 4: Click the button on the right of [Function], and then click [Noise] in the displayed list.
Change the numeric value on the right of [Amplitude] from [65534] to [15000].
Click the Page OK button to return to the operate screen.

Step 5: Click the = button to display a waveform created by adding a sine wave and noise in the waveform display area in the right part of the screen.

Step 6: Click the OK button to return to the waveform display screen.
A waveform was created by superimposing noise on a sine wave.

Explanation 1: Subtraction, multiplication, and division operations can be used, in addition to the addition operation used in this example.

Explanation 2: Calculation can be performed for a section of the waveform by selecting the section of the waveform using markers A and B on the waveform display screen in advance.

Explanation 3: This example uses a waveform created on the waveform generation screen for the calculation.
Click the Clip Board button in Step 3 to use the content in the clipboard for the calculation. Clipboard ➡ "3.4 Copying and Pasting Waveform"

Explanation 4: When using the multiplication operation, it is convenient to select ±1 (user unit) for the vertical axis, like with one the examples in "3.5 Mathematical Expression Waveform".
When multiplying two full-scale values in this way, the result is also a full-scale value.

3.10 Editing Digital Pattern

As the last example, create a stepped waveform based on a triangular wave using the digital pattern editing function.

Step 1: Click the button in the upper left part of the screen. The sine wave is selected by default.
Click the button on the right of [Function], and then click [Triangle] in the list.
Click the All Pages OK button to return to the waveform display screen.

Step 2: By default, the button in the upper left part of the screen is pressed.
At this point, click the button in the upper left part of the screen to change to a display similar to the screen of the logic analyzer. This display is called a digital pattern display.
DF0106 handles waveform data using 16-bit digital values, and the corresponding 16-bit lines are displayed in the digital pattern display.

Step 3: Click the appropriate bit line to change the display color. A bit line whose display color is changed from blue to light blue or from black to green indicates that it is selected. First, click the bit line at the bottom. Then, click the 2nd, 3rd, ... and 10th bit lines from the bottom while holding down the Ctrl key.
Check that the display color of all 10 bit lines from the bottom has changed to light blue or green.

Step 4: At this point, click the 0 button in the upper left part of the bit display.
All of the selected bits are set to 0 (low level).

Step 5: Then, click the 6th bit from the top (the 11th bit from the bottom) while not holding down any key. Then, click the 1 button in the upper left part of the bit display. All of the selected bits are set to 1 (high level).

Step 6: Click the button in the upper left part of the screen in this state.
A stepped waveform with 32 steps is displayed.

Explanation 1: Digital pattern editing can be performed for a section of the waveform by selecting the section of the waveform using markers A and B on the waveform display screen in advance. After Step 1, move marker A to the first one-fourth and marker B to the last one-fourth, and then perform Step 2 and the subsequent steps to see how the editing function works.

Explanation 2: Select a bit and then click the Invert (/) button to logically invert the selected bit. After Step 1, select the lower 11 bits and click the Invert (/) button to create an interesting waveform.

Explanation 3: The Pattern (*) button on the right end and the input field on its right are for specifying a logical pattern. ➡ "4.9.5 Pattern Expression"

4. Operation on Waveform Display Screen

The display that appears when "DF0106 Arbitrary Waveform Editor" is started is called a waveform display screen. How to Start ➡"3.2 Starting and Exiting DF0106"
This chapter describes the functions and operation on the waveform display screen.

This chapter uses the following notation rules.

- A menu name displayed on the screen, string entered by the user, etc. are expressed in sans-serif font and enclosed in brackets [ ].
  Examples: [Function], [s=2*pi;]
- A button name displayed on the screen, key operated by the user, etc. are expressed in sans-serif font and enclosed in ☐.
  Examples: Cancel, OK, Alt
- When a key is to be pressed while holding down another key, this is represented by connecting the keys with the plus sign (+). Example: Ctrl + O
- When a key is to be pressed after pressing and releasing another key, this is represented by connecting the keys with a comma (,). Example: Alt, F

4.1 Configuration and Functions of Waveform Display Screen

Figure 4-1 Waveform Display Screen shows the part names of the waveform display screen.

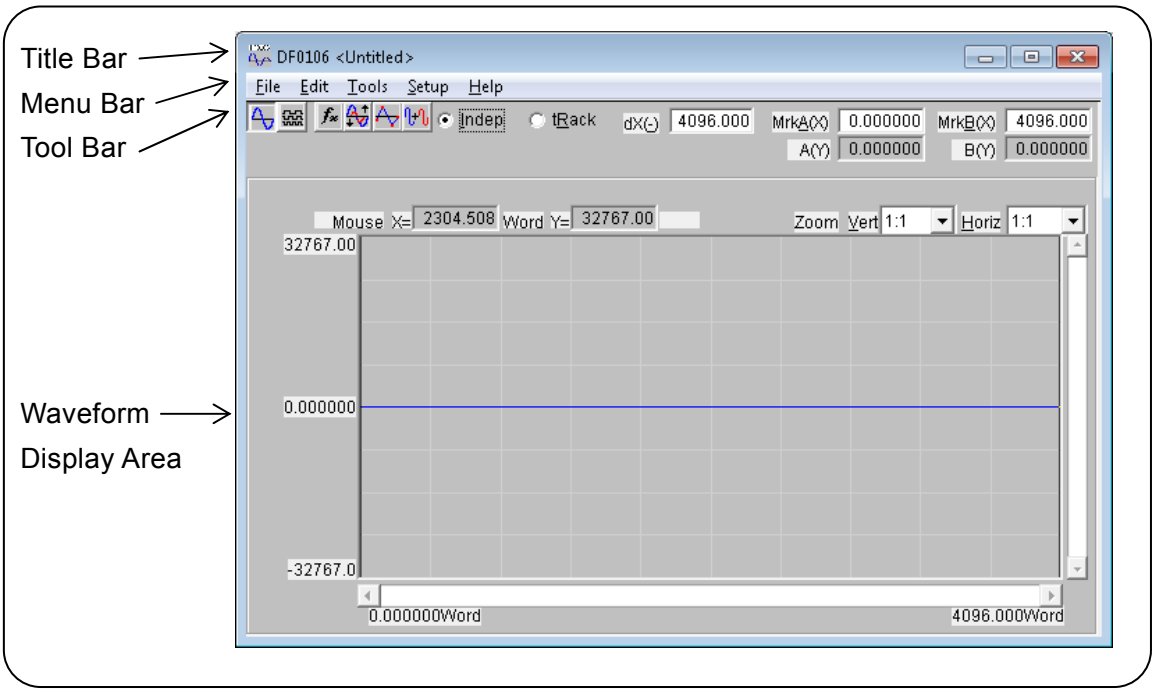


Figure 4-1 Waveform Display Screen

The title bar displays the name of a file from which to read or to which to write the waveform data. When neither read nor write was performed for the file, [<Untitled>] is displayed.
For more information on the standard functions, operation procedures, etc. of the title bar buttons, refer to the Windows manual.

The menu bar has a pull-down menu.

Click a menu name to display the menu options. Click an option to execute the function.
Or press the Alt key and then press the underlined alphabet letter key on the right of the menu name to display the options for that menu (example: Press Alt, F to display the options for the [File] menu).
Furthermore, press the underlined alphabet letter key on the right of the option to execute the function.
If [Ctrl + *] (* indicates an alphabet letter) is displayed on the right of a menu option, click it to execute the function directly when the menu option is not displayed. (Example: [Ctrl + V] is displayed on the right of [Paste] in the [Edit] menu. The Ctrl+V operation is the same as the operation: [Edit] – [Paste].)

The tool bar includes buttons for frequently used functions and marker setting/display area.


: Normal Waveform Display


: Digital Pattern Display


: Waveform Generation Screen ➡ "5.1 Standard and Mathematical expression waveform generation"


: Compress/Expand Screen ➡ "5.2 Waveform Compression/Expansion"


: Interpolation Editing Screen ➡ "5.3 Waveform Generation through Interpolation"


: Operation Screen ➡ "5.4 Operate between Waveforms"

[Indep], [tRack]:	Selects the marker's operation mode.
[dX(-)]:	Sets/displays the difference in the marker's horizontal direction position.
[MrkA(X)], [MrkB(X)]:	Sets/displays the marker's horizontal direction position.
[A (Y)], [B (Y)]:	Displays the waveform's vertical position at the marker position.

The waveform display area includes waveform or digital pattern display, display zoom selection, and mouse pointer position display.

In items with an underlined alphabet letter displayed on the right of the item name on the tool bar and in the waveform display area, press the underlined alphabet letter key while holding down the Alt key to select the item.
For example, the Alt + H operation (press the H key while holding down the Alt key) selects an item in [Zoom Horiz]. Note that the Alt , H operation (press the Alt key and then press the H key) displays the options in the [Help] menu on the menu bar.
Needless to say, clicking the input/display area on the right of an item name selects the item.

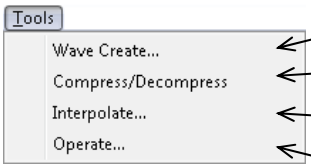
Example: MrkA(X) 0.000000
Click here, or perform the Alt + A operation.

Or click ○ (option button) on the left of the item name to select the function (◉ indicates the selected state).

Example: ○ tRack
Click here, or perform the Alt + R operation.

4.2 Tool Menu

The Tool menu options are as follows.



Opens the waveform generation screen, as with the button on the tool bar.
Opens the compress/expand screen, as with the button on the tool bar.
Opens the interpolation editing screen, as with the button on the tool bar.
Opens the Operation screen, as with the button on the tool bar.

For example, the Alt, T, C operation opens the waveform generation screen.

Waveform Generation Screen	➡	"5.1 Standard and Mathematical expression waveform generation"
Compress/Expand Screen	➡	"5.2 Waveform Compression/Expansion"
Interpolation Editing Screen	➡	"5.3 Waveform Generation through Interpolation"
Operation Screen	➡	"5.4 Operate between Waveforms"

4.3 Settings Menu

The Settings menu options are as follows.

Opens the system settings screen
Turns on/off the grid display in the waveform display area

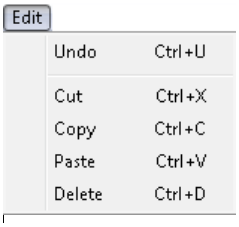
Click [Setup] – [Setup] (Alt, S, S) to open the system settings screen.
The system settings screen allows users to select the signal generator model, set the main parameters, transfer, waveform data transfer, display unit, etc. ➡ "5.5 Waveform and settings transfer"

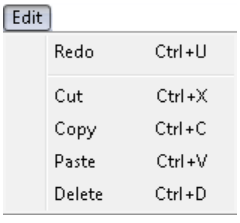
Click [Setup] – [Show Grid] (Alt, S, G) to turn on and off the grid display in the waveform display area.

When the waveform is printed, the grid is not printed. ➡ "4.7.6 Printing"

4.4 Undoing and Redoing

DF0106 allows users to return to the previous step (undo) after performing a step in the waveform creation or editing operation. Click [Edit] – [Undo] (Alt, E, U) or perform the Ctrl + U operation to return to the previous step.
To cancel the operation after returning to the previous step (redo), click [Edit] – [Redo] (Alt, E, R) or perform the Ctrl + U operation.





4.5 Zooming and Scrolling Display

4.5.1 Vertical Zoom

The waveform display can be zoomed independently vertically and horizontally. The digital pattern display cannot be zoomed vertically.

The waveform can be zoomed vertically with a zoom ratio of [1 : 1] (display the entire waveform), [1 : 2] (zoom half of the waveform to the entire screen), [1 : 4] ... up to [1:256].

Click the ▼ button on the right of [Zoom Vert] and click the desired zoom ratio from the displayed list.

Press Alt + V to select [Zoom Vert], and then press the ↓ key or the → key to increase the zoom ratio, and press the ↑ key or the ← key to decrease the zoom ratio. Press the Home key to not apply zoom, and press the End key to select the maximum zoom ratio.

4.5.2 Horizontal Zoom

The waveform can be zoomed horizontally with a zoom ratio of [1 : 1] (display the entire waveform), [1 : 2] (zoom half of the waveform to the entire screen), [1 : 4] ... up to [1:128].

Click the ▼ button on the right of [Zoom Horiz] and click the desired zoom ratio from the displayed list.

Press Alt + H to select [Zoom Horiz], and then press the ↓ key or the → key to increase the zoom ratio, and press the ↑ key or the ← key to decrease the zoom ratio. Press the Home key to not apply zoom, and press the End key to select the maximum zoom ratio.

4.5.3 Scrolling

When the vertical/horizontal zoom ratio becomes greater than [1 : 2], a scroll button appears in the scroll bar.

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

Click the scroll button to cause it to flash. Press the ↓ key or the → key in this state to move the display position right or down. Or, press the ↑ key or the ← key to move the display position left or up. Press PageUp/PageDown to move the display position in greater increments.

Press the Home key to move the display position to the left end or top, and press the End key to move it to the right end or bottom.

4.6 Markers and Selecting Range

Markers are used to select the horizontal range of the waveform to edit and create various waveforms. Furthermore, they are also used to specify the horizontal position and read the vertical values of the waveform.

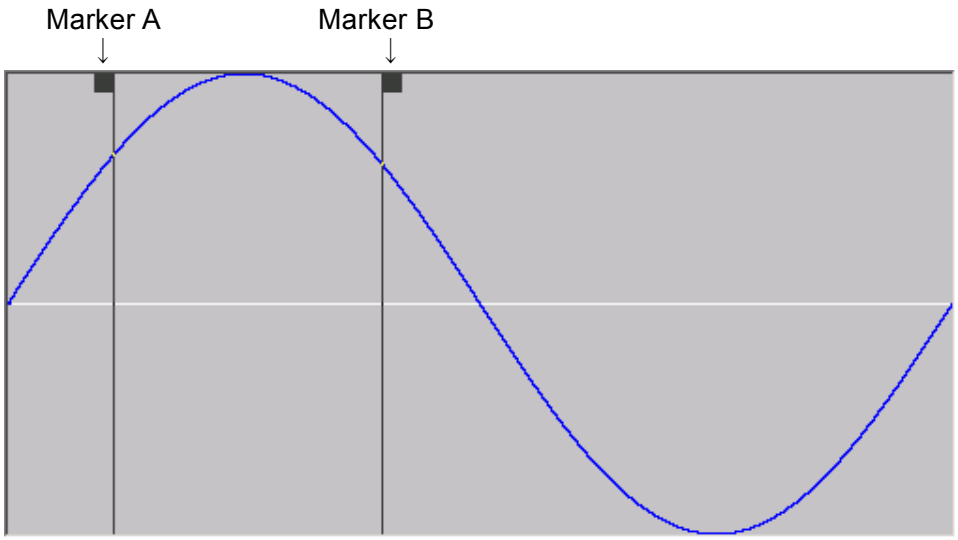
The markers of DF0106 are displayed as vertical lines in the waveform display area.

4.6.1 Marker Operation

a) Types of Markers

There are two markers used in DF0106, marker A and marker B.

Marker A cannot be set on the right of marker B. Marker A is always positioned on the left of marker B or in the same position as marker B.



The position of each marker is displayed on the right of [MrkA(X)] and [MrkB(X)], respectively.

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

b) Move Marker (Drag with Mouse)

There are two ways to move the marker. One is to drag it with the mouse, and the other is to specify values. When the mouse cursor is moved to the same horizontal position as the marker, the mouse cursor shape changes from ↖ to ↔. Dragging the mouse cursor in this state moves the marker. If the marker is at the left or right end, it is difficult to see the marker. If the mouse cursor is moved to the left or right end, the mouse cursor shape is changed to ↔.

When moving the marker by dragging it with the mouse, it is moved by a waveform data address unit. If a display pixel is equivalent to multiple addresses in the display magnification, the marker is moved using the address corresponding to a display pixel as a step.

c) Move Marker (Numeric Value Setting)

To specify the marker position with a higher resolution, enter the numbers directly.

Click right of [MrkA(X)], or perform the Alt + A operation to select the position display field of marker A. When you enter a numeric value here and then press the Enter key, marker A jumps to the specified position.

Likewise, when you click the right of [MrkB(X)], or perform the Alt + B operation, and enter a numeric value in the position display field of marker B and then press the Enter key, marker B jumps to the specified position.

When you use the numeric value setting, you can specify the marker position freely in the range of the setting/display resolution without being restricted by the waveform data address.

d) Marker Link Mode

When ○ (option button) on the left of [○ Indep] on the tool bar is selected (◉), marker A and marker B move independently from each other.

Click the option button on the left of [tRack], or perform the Alt + R operation to link marker A and marker B.

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

When you move one marker, the other marker also moves with a constant difference.

When you click the right of [dX(-)], or perform the Alt + - operation, and enter a numeric value and then press the Enter key, marker B jumps to reach the specified difference.

4.6.2 Selecting Range

The following ranges can be selected by the markers.

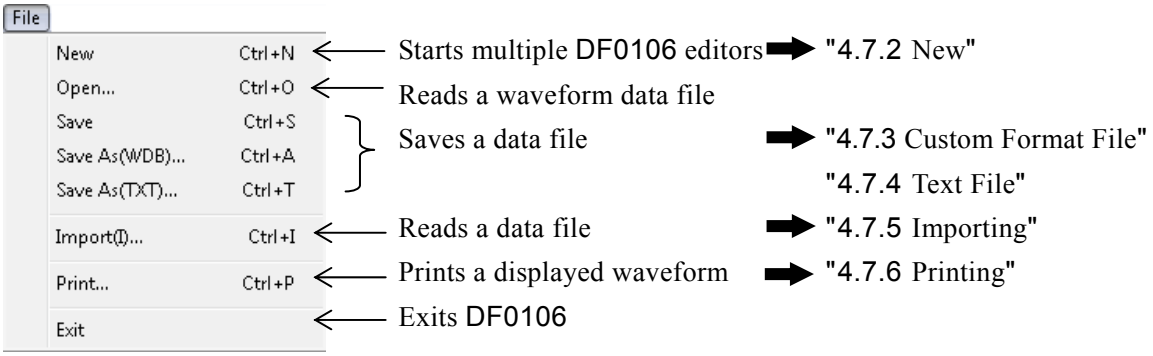
- Range to copy, cut, and paste the waveform ➡ "4.8 Copying and Pasting"
- Range to compress/expand ➡ "5.2 Waveform Compression/Expansion"
- Range to generate a waveform by interpolation ➡ "5.3 Waveform Generation through Interpolation"
- Range to perform operations ➡ "5.4 Operate between Waveforms"

Strictly speaking, the markers are located "directly in front of" the set/displayed horizontal axis position (indicated by the numeric value on the right of [MrkA(X)] and [MrkB(X)].

For example, if the horizontal axis position of marker A is 5 and the horizontal axis position of marker B is 10, the selected range is 5 <= X < 10. Marker A is located directly in front of 5, so 5 is located between marker A and marker B. Marker B is located directly in front of 10, so 10 is not located between marker A and marker B.

4.7 File Operations and Printing

The File menu options are as follows.



The name of a file that was read and saved is displayed on the title bar.

4.7.1 Types of Files

DF0106 can read the following types of files. ( ) indicates the file extension added to the end of the file.

- Custom format file (.WDB) containing waveform data, signal generator settings, display unit settings, etc. ➡ "4.7.3 Custom Format File"
- Text file (.TXT) containing only waveform data. ➡ "4.7.4 Text File"
- Custom format text file (.WFN) containing standard waveform type and its parameters, and the constants and expression of the mathematical expression waveform. ➡ "5.1.5 File operations"
- Text file (.PRN, .TSV, .CSV) containing only control points. ➡ "5.3.3 File operations"
- DF0106-specific file (.OCB) containing signal generator settings, display unit settings, etc. ➡ "5.5.7 File operations"

4.7.2 New

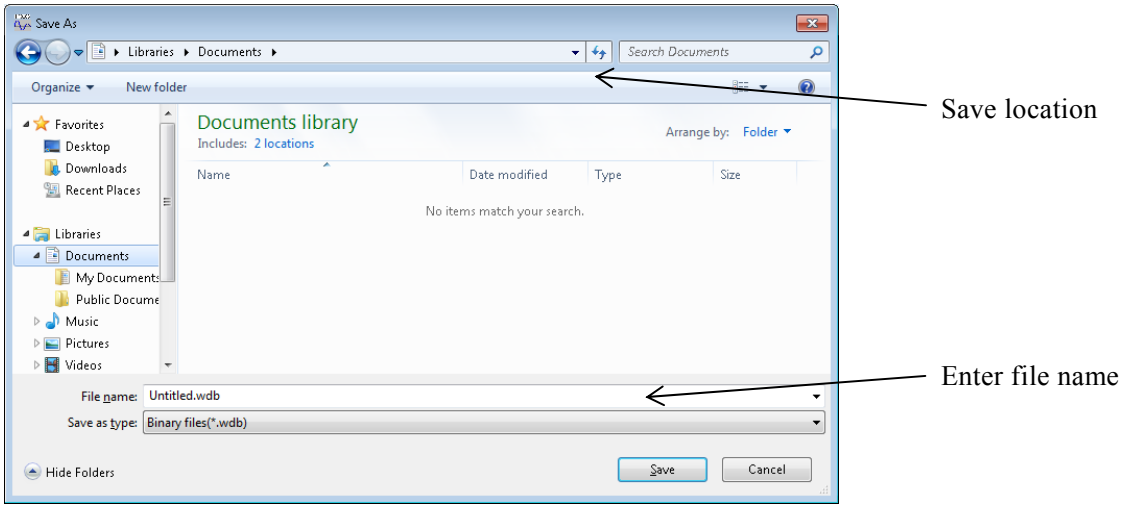
Click [File] – [New] (Alt, F, N or Ctrl + N) to open another DF0106 editor. Another editor is opened at the same position where the first DF0106 was opened.

Data can be exchanged among multiple DC0106 editors via the clipboard.
➡ "4.8.2 Clipboard", "5.4.2 Object of Operation"

4.7.3 Custom Format File

Almost all necessary information such as waveform data, signal generator settings, and display unit settings created in DF0106 can be stored in this file. This is a custom format binary file that is smaller in size than a text file.

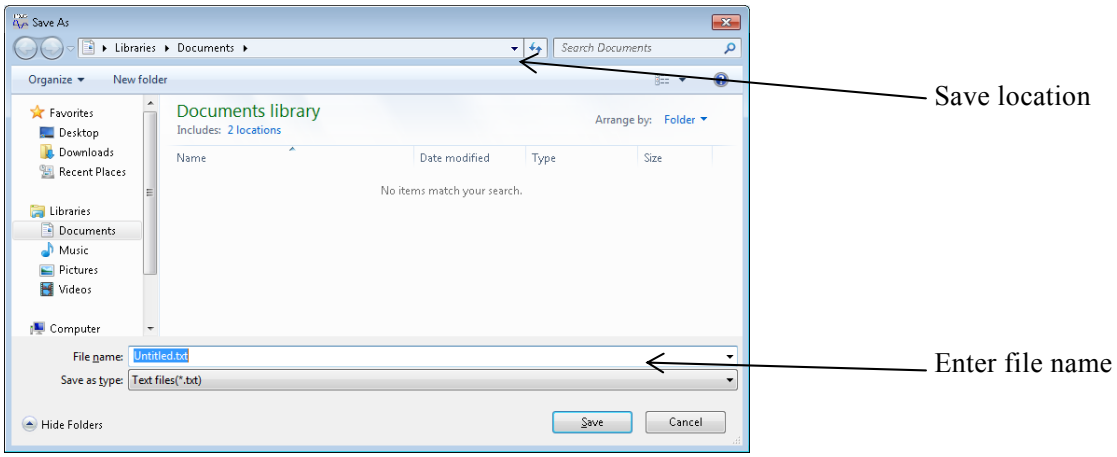
Click [File] – [Save As(WDB)] (Alt, F, A or Ctrl + A) to display a screen titled [Save as]. Select the save location, enter the file name, and then click the Save button. The file extension is ".wdb," which can be omitted when entering the file name.



4.7.4 Text File

Waveform data created by DF0106 can also be saved as a text file to ensure it can also be used in other applications.

Click [File] – [Save As(TXT)] (Alt, F, T or Ctrl + T) to display a screen titled [Save as].



Select the save location, enter the file name, and then click the Save button. The file extension is ".txt" which can be omitted when entering the file name.

16-bit (0 to +65535) equivalent data is saved as a "one piece of data per line" number string in a text file. The number of lines is the same as the memory size set on the system settings screen.
This file can be used directly by text editor, spreadsheet and etc.

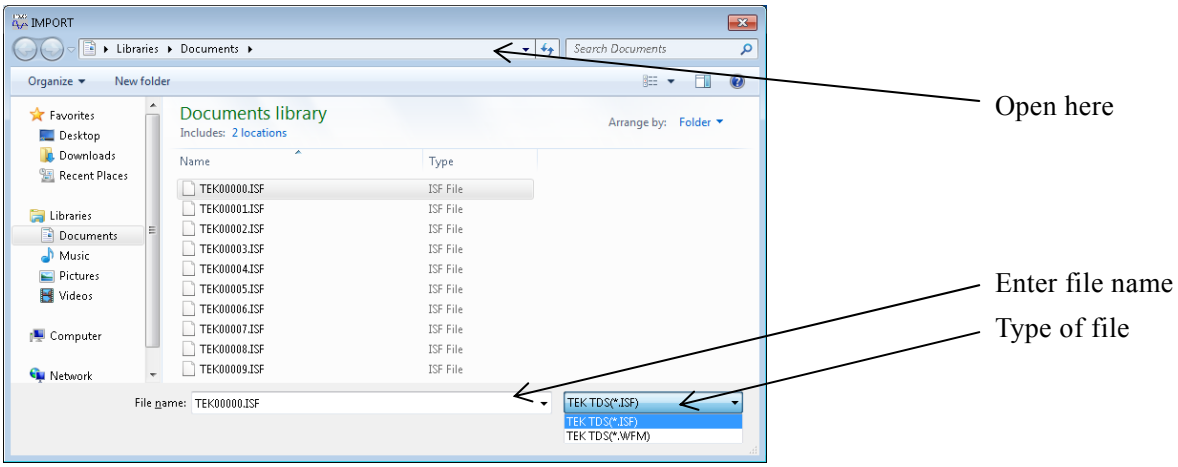
Conversely, a text file created by a text editor, spreadsheet, etc., can be loaded into DF0106. When creating a text file, make sure that data is one piece of data per line and a 16-bit signed integer (-32768 to +32767).

The number of pieces of data in a data file must be 65536 or less. If the number of pieces of data in the data file is greater than [Wave Memory Setup - Memory Size] in the system settings, the exceeding part will be skipped.
Conversely, if the number of pieces of data is less, data will be loaded into the top part of the waveform and the remaining part will not change.

4.7.5 Importing

Waveform data created by other than DF0106 can be imported as DF0106 waveform data.

Click [File] – [Import] (Alt, F, I or Ctrl + I) to display a screen titled [Import].



Select the type of file. Select the file location, enter the file name, and then click the Open button.
If data is already loaded from a custom format or text format file, <Untitled> is displayed in the title of the waveform display screen.

If the number of pieces of data in the data file specified in Import is greater than [Wave Memory Setup - Memory Size] in the system settings, compression processing is performed. The original data is compressed to fit the waveform data memory size and then imported.
Conversely, if the number of pieces of data is less, data will be loaded into the top part of the waveform and the remaining part will not change.

■ CAUTION ■

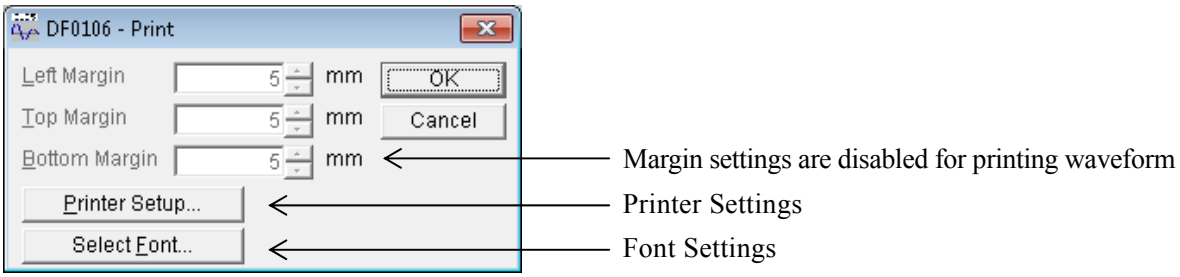
Data cannot be saved in the data file format used to import the data.

4.7.6 Printing

Waveform data created by DF0106 can also be printed as a waveform. However, the grid is not printed.

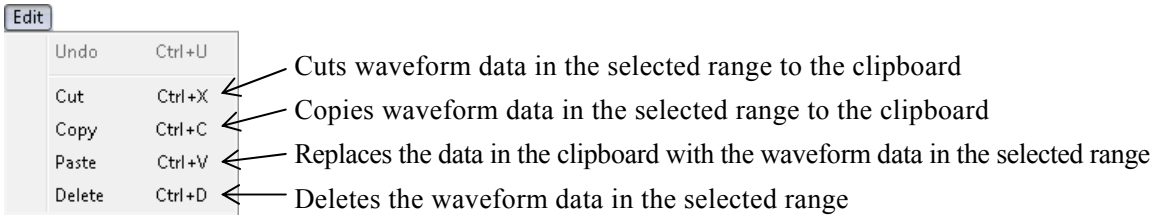
➡ "4.3 Settings Menu"

Click [File] – [Print] (Alt, F, P or Ctrl + P) to display a screen titled [DF0106-Print].
If necessary, set the printer or font, and then click the OK button.
The top, bottom, and left margins cannot be set for printing a waveform.



4.8 Copying and Pasting

DF0106 allows users to edit a waveform by cutting, copying, and pasting the waveform data.



4.8.1 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 more information on each edit operation, refer to "Figure 4-2 Waveform Editing Operation".

4.8.2 Clipboard

When you perform the cut or copy operation, the waveform data in the selected area is sent to the clipboard.
A clipboard is a temporary data storage area provided in Windows.
As for the waveform data in the selected area, 16-bit (-32768 to +32767) equivalent data is sent to the clipboard as a "one piece of data per line" number string.
This data can also be pasted as is to a text editor, spreadsheet, etc., as well as to DF0106 or other multiple running DF0106 editors.

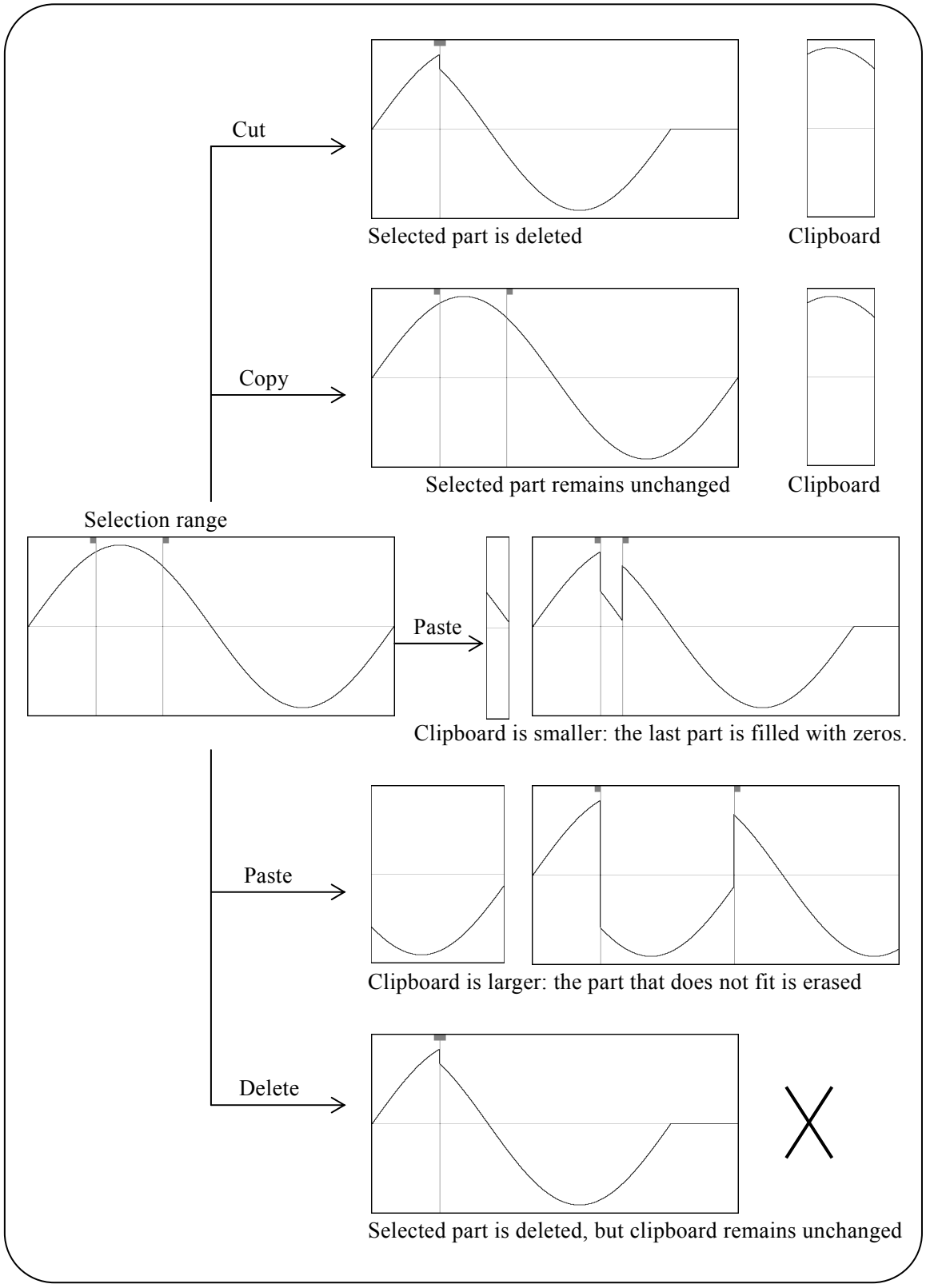


Figure 4-2 Waveform Editing Operation

4.9 Digital Pattern

DF0106 internally handles waveform data as 16-bit integers (-32768 to 32767).
The data can also be displayed/edited as a 16-line 0/1 digital waveform.

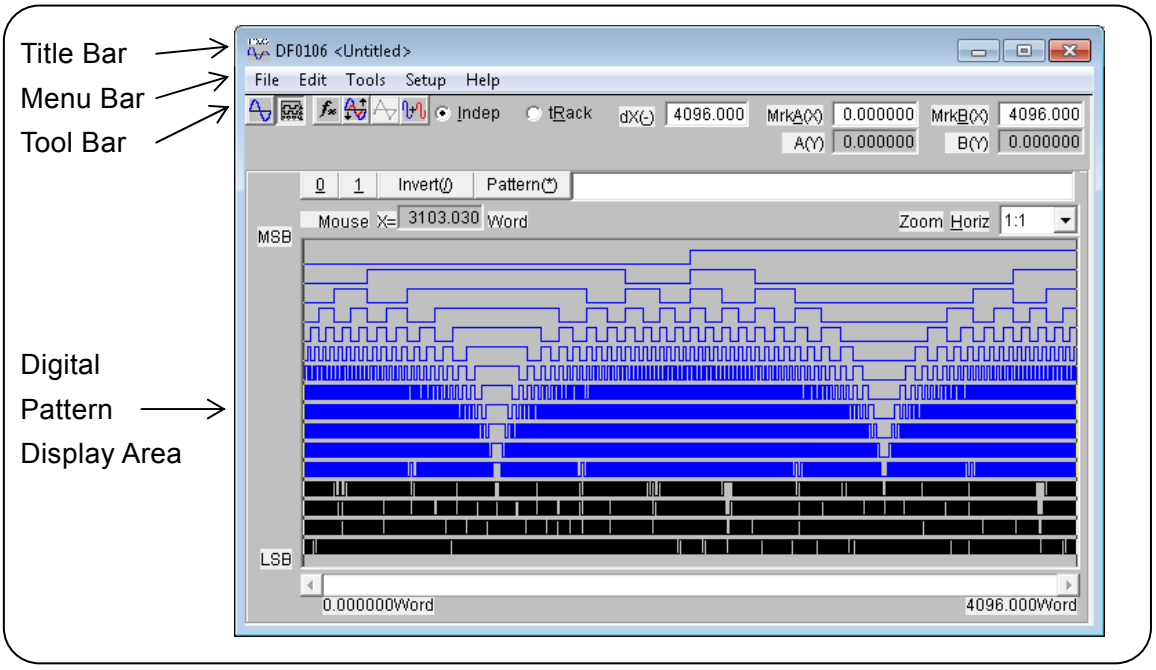


Figure 4-3 Digital Pattern Display

4.9.1 Switching Display

A display switch button on the tool bar is used to switch between normal waveform display and digital pattern display.

- → Normal Waveform Display
- → Digital Pattern Display

4.9.2 Selecting Range

The digital pattern editing operation is basically performed for the selected range.
The way to select the range by markers is the same as that for normal waveforms.

➡ "4.6.2 Selecting Range"

The copy/paste and other editing operations are also the same as with the waveform display.

➡ "4.8 Copying and Pasting"

4.9.3 Selecting and Copying Bit

The operation in "4.9.4 0/1/Invert" is performed for the selected range of the selected bit.
The display color of the selected bit changes from blue to light blue or from black to green.

Bit Displayed in Black ➡ "4.9.6 Invalid Bit"

Click the bit display in the selected range to select the bit.
Click the bit while holding down the Ctrl key to select multiple bits.

Drag a bit to another bit to copy the bit data in the selected range.

4.9.4 0/1/Invert

You can select 0 (low level), 1 (high level), and logical inversion for the range selected by markers (the light blue or green area) of the selected bit.

- 0 → Click the 0 button in the upper left part of the bit display, or press Alt + 0
- 1 → Click the 1 button in the upper left part of the bit display, or press Alt + 1
- Invert → Click the Invert (/) button, or press Alt+/

However, the Alt + 0 and Alt + 1 operations cannot be performed by using 0 1 on the numeric keypad. Use the number keys above the alphabet letter keys.

4.9.5 Pattern Expression

Enter the pattern expression in the input field on the right of the Pattern (*) button and then click the Pattern (*) button to apply the pattern expression.
The pattern expression is applied for the range selected by markers A and B.
Bit selection does not influence the application of the pattern expression.
To specify multiple pattern expressions, insert a colon (:) between the expressions.
The pattern expression format is as follows.

a) Specify Mask

[Function]: Specify the bit to which the subsequent pattern expression is applied.

[Format]: Mask value Values 0 to 65535 are valid
Add $ to create a hex number representation. $0000 to $FFFF are valid
When the mask is not specified, it is equivalent to Mask $FFFF
The value can also be represented using a calculation expression

[Example]: Mask 15 (Mask $F)
→ The subsequent pattern expression is applied to the low-order 4 bits
Mask 65534 (Mask $FFFE)
→ The subsequent pattern expression is applied to all bits except for LSB.
Mask 2^5+2^7 (Mask 32+128、Mask $20+$80)
→ The subsequent expression is applied to LSB to the 6th bit (D5) and the 8th bit (D7).

b) Specify Bit

[Function]: Specify one word data using h/l/n/z enclosed in { }.
However, bits not specified by the mask do not change.

[Format]:

h	Sets 1 (high level) for the bit.
l	Sets 0 (low level) for the bit.
n	Inverts the bit.
z	Leaves the bit as is.

Describe a sequencer of 16 bits in { }.
If the number of bits is less than 16, high-order bits not specified do not change.
Number indicating the number of repeats can be added to the top.

[Example]:

{hhhhhhhhllllllll}	→	Sets 1 for the high-order 8 bits and 0 for the low-order 8 bits of the first address data in the range specified by markers.
1024{llllhhhh}	→	Sets 1 for the least significant 4 bits and 0 for the upper 4 bits thereof of the 1024 data from the first address in the range specified by markers. The high-order 8 bits do not change.

c) Specify All Bits at Once

[Function]: Sets 1, 0, invert, or no change for all bits specified by the mask.

[Format]:

H	Sets 1 (high level) for all bits specified by the mask. Same as {hhhhhhhhhhhhhhhh}
L	Sets 0 (low level) for all bits specified by the mask. Same as {llllllllllllllll}
N	Inverts all bits specified by the mask. Same as {nnnnnnnnnnnnnnn}
Z	Leaves all bits specified by the mask as is. Same as {zzzzzzzzzzzzzzzz}

Number indicating the number of repeats can be added to the top.

[Example]:

18H14L30N2Z	→	Sets 1 for the first 18 addresses, 0 for the subsequent 14 addresses, inverts the subsequent 30 addresses, and leaves the subsequent 2 addresses as is for all bits specified by the mask.

d) Immediate Value

[Function]: Specify one word data for some numeric values.
However, bits not specified by the mask do not change.

[Format]:

# value	Values 0 to 65535 are valid. Add $ to create a hex number representation. $0000 to $FFFF are valid The value can also be represented using a calculation expression

[Example]: #255 → Sets 255 for the first address data in the range specified by markers.
That is, sets 1 for the low-order 8 bits.

1024#65535 512#511 → Sets 65535 (all bits: 1) for the 1024 data and 511 (low-order 9 bits: 1) for the subsequent 512 data from the first address in the range specified by markers.

e) Repeat

[Function]: Specify one word data for some numeric values.
However, bits not specified by the mask do not change.

[Format]: Value [Pattern Expression]

The value is the number of repeats. 0 to 32767 are valid.
A value of 0 indicates infinite repeats (until the end of the range selected by markers).
Add $ to create a hex number representation. $0000 to $FFFF are valid
The value can also be represented using a calculation expression

[Example]: 0[HL] → Sets 10101010.... for all bits in the range specified by markers.

0[NZ] → Inverts every other bit for all bits in the range specified by markers.

f) Application Examples

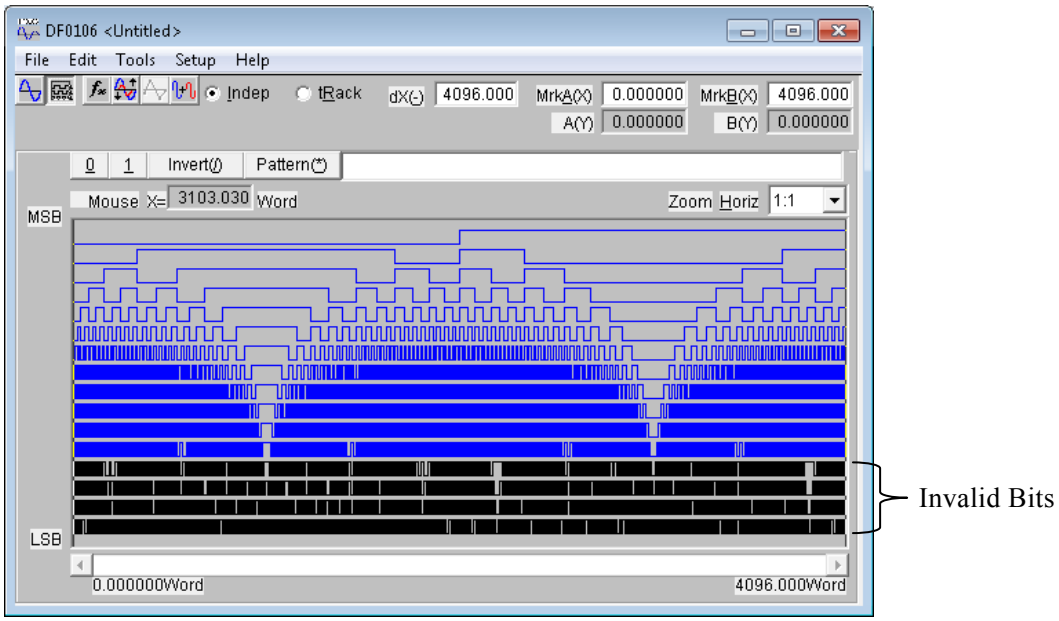
- Mask 1+4 0[HHH2[LL2*2[HL]HH]]
  → Repeat the pattern "11100101010110010101010 11" in bit 0 (LSB) and bit 2 in the selected range.

- 0[{hn}]: Mask 2^2 500[H] Mask 2^3 500[HL]
  → First, inverts bit 0 (LSB) and sets "1" for bit 1 in the range selected by markers.
  Then, sets "1" for bit 2 for the 500 words at the top of the range selected by markers.
  Then, repeats 10 for bit 3 for the subsequent 1000 words.

- Mask $1 0[16H16L]: Mask $2 0[32L224H]: Mask $4 0[256H768L512H512L]
  → Uses LSB as the clock source and repeats 16-word 1/16-word 0.
  Uses bit 1 as the slope source and repeats 32-word 0/224-word 1.
  Uses bit 2 as the data signal source and repeats 256-word 1/768-word 0/512-word 1/512-word 0.

4.9.6 Invalid Bit

Whereas the DA converter of DF1906 is a 12-bit, DF0106 handles the waveform data in 16-bit. Therefore, the lower 4 bits of waveform data of DF0106 does not affect the output of the DF1906. These bits are referred to as invalid bits. Invalid bits in the digital pattern are displayed in black.



(Blank)

5. Other screen operations

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

Opening each screen ➡ "4.1 Configuration and Functions of Waveform Display Screen"
(Toolbar description)
➡ "4.2 Tool Menu"

The descriptions in this chapter use the following conventions.

- Menu item names and user-entered text are displayed in sans-serif font within square brackets [ ].
  Example: [Function], [s=2*pi;]
- Buttons displayed on the screen and user-operated keys are displayed as sans-serif text within boxes ☐.
  Example: Cancel, OK, Alt
- "+" indicates that a key is to be pressed while pressing another key. Example: Ctrl + O
- ", " indicates that a key is to be pressed after pressing and releasing another key. Example: Alt, F

5.1 Standard and Mathematical expression waveform generation

Standard waveforms and mathematical expression waveforms are created using the Waveform Generation screen.

Click the f_w button on the toolbar or click [Tools] – [Waveform Create] (or press Alt, T, C.

To revert to the previous waveform immediately after returning to the waveform display screen with the waveform created by the Waveform Generation screen, click [Edit] – [Undo] (or press Alt, E, U), or press Ctrl + U.

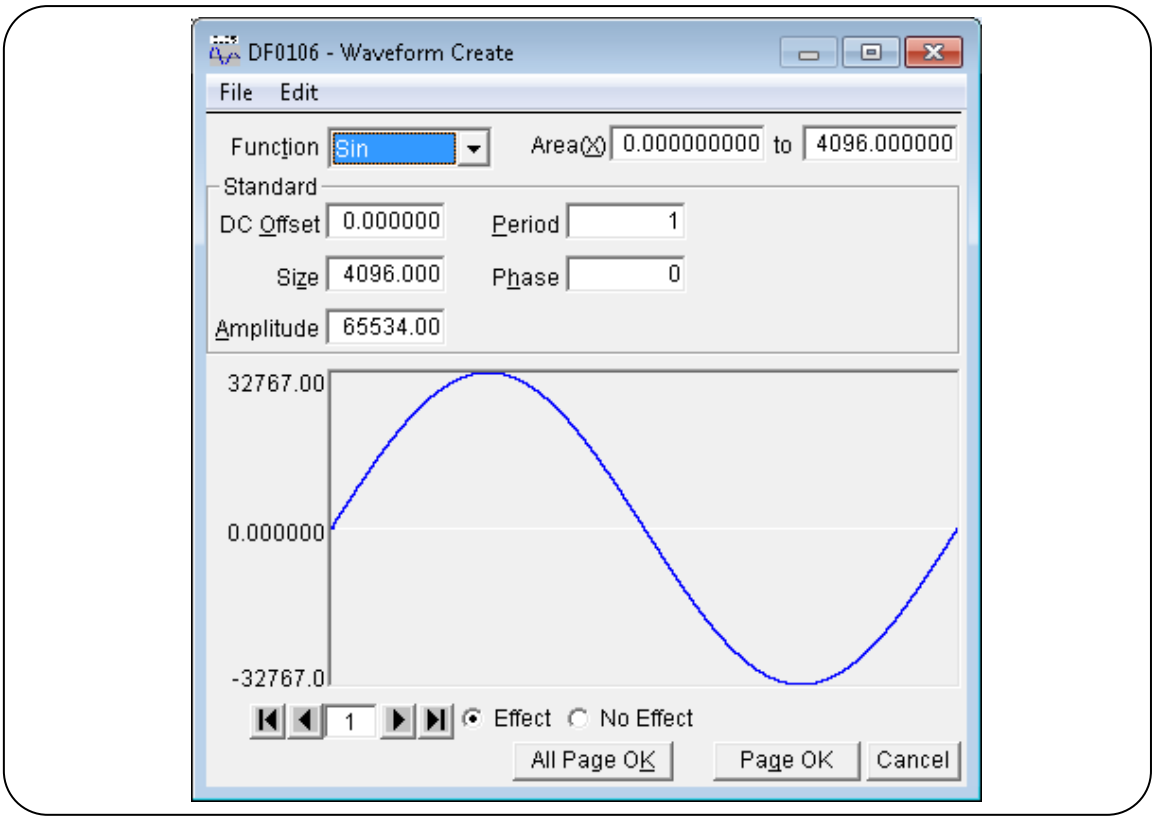


Figure 5-1 Waveform Generation screen

5.1.1 Range settings and pages

On the Waveform Generation screen, waveforms are created by assigning a "Range" and "Waveform Definition" independently for each page (the range specified by the markers on the waveform display screen has no affect on the Waveform Generation screen).

The range of each page is set by the two numbers entered to the right of [Area(X)].
When the range overlaps multiple pages, the waveform definition of the higher (latest) page number is valid. This can be used to alter the portion of a waveform defined on earlier pages by changing a later page.
Each page can also be independently enabled or disabled. Click either [○ Effect] or [○ No Effect] (○ option buttons) at the lower part of the screen to switch to the ◉ (selected state) for each page.

Use the ◀ and ▶ buttons at the lower left of the Waveform Generation screen to move from page to page. Click the ◀ button to move to the previous page, and the ▶ button to move to the next page. Click the ⏮ button to jump to the first enabled page. Click the ⏭ button to jump to the last enabled page.
To jump to a specific page, enter the page number between the buttons and press Enter. The page number can be 1 to 200.

To return the current page's settings to their default values, click [Edit] – [Page Clear] (or press Alt, E, P).
To return all page's settings to their default values, on the Waveform Generation screen, click [Edit] – [All Page Clear] (or press Alt, E, A).

To create only the waveform for the displayed page, click the Page OK button at the bottom of the screen.
To create waveforms for all pages at once, click the All Pages 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.

5.1.2 Waveform selection

On the Waveform Generation screen, click the ▼ button to the right of [Function] to display the list of available waveforms, and click to select the one desired.
You can also press Alt + T [Function] and the ↓ / ↑ (or → / ←) keys to select the desired waveform.
As noise is generated based on random number calculations, different waveform data is produced every time.
DC gives the same data through the specified range.
The function "Expression" defines waveforms according to mathematical expression.

➡ "5.1.4 Mathematical Expression Waveform"

5.1.3 Parameter setting

The parameters in "Table 5-1 Standard waveform parameters" can be set for each sine wave, triangle wave, square wave, noise and DC.

Table 5-1 Standard waveform parameters

	Sine Wave	Triangle Wave	Square Wave	Noise	DC Volts
DC Offset	○	○	○	○	○
Size	○	○	○	○	○
Amplitude	○	○	○	○	—
Period	○	○	○	—	—
Phase	○	○	○	—	—
Symmetry	—	○	—	—	—
Duty Ratio	—	—	○	—	—
Transition	—	—	○	—	—

Size is the (upper limit) – (lower limit) of specified page area (X). Changing the size changes the upper limit of the specified range.
Amplitude is the peak-to-peak value.
The period specifies how many periods there are within the range.
Phase is in degree (°) units.
The symmetry can be set for triangle waves. Symmetry is in % units.
The duty cycle and transition can be set for square waves. Duty cycle is in % units. Transition is the time required to reach the peak value 0%⇔100%, specified as a percentage (%) of the period.

When the specified [DC Offset] or [Amplitude] causes the ±full-scale value to be exceeded, the waveform is clipped at ±full-scale.

The shape of the mouse cursor changes to ✥ or ⤡ when moved to the waveform display area of the Waveform Generation screen.
Dragging the mouse in the ✥ state moves the waveform up, down, left and right. Dragging it up/down changes the [DC Offset], and dragging it left/right changes the [Phase].
Dragging the mouse in the ⤡ state stretches the waveform up, down, left and right. Dragging it up/down changes the [Amplitude], and dragging it left/right changes the [Period].
Parameters can be set intuitively while viewing the waveform with ✥ and ⤡. Using this method, after making approximate settings, more refined values can be specified by numerical input.

5.1.4 Mathematical Expression Waveform

When the "5.1.2 Waveform selection" is [Expression], the [Constant] and mathematical exapression input [Y=] sections appear.

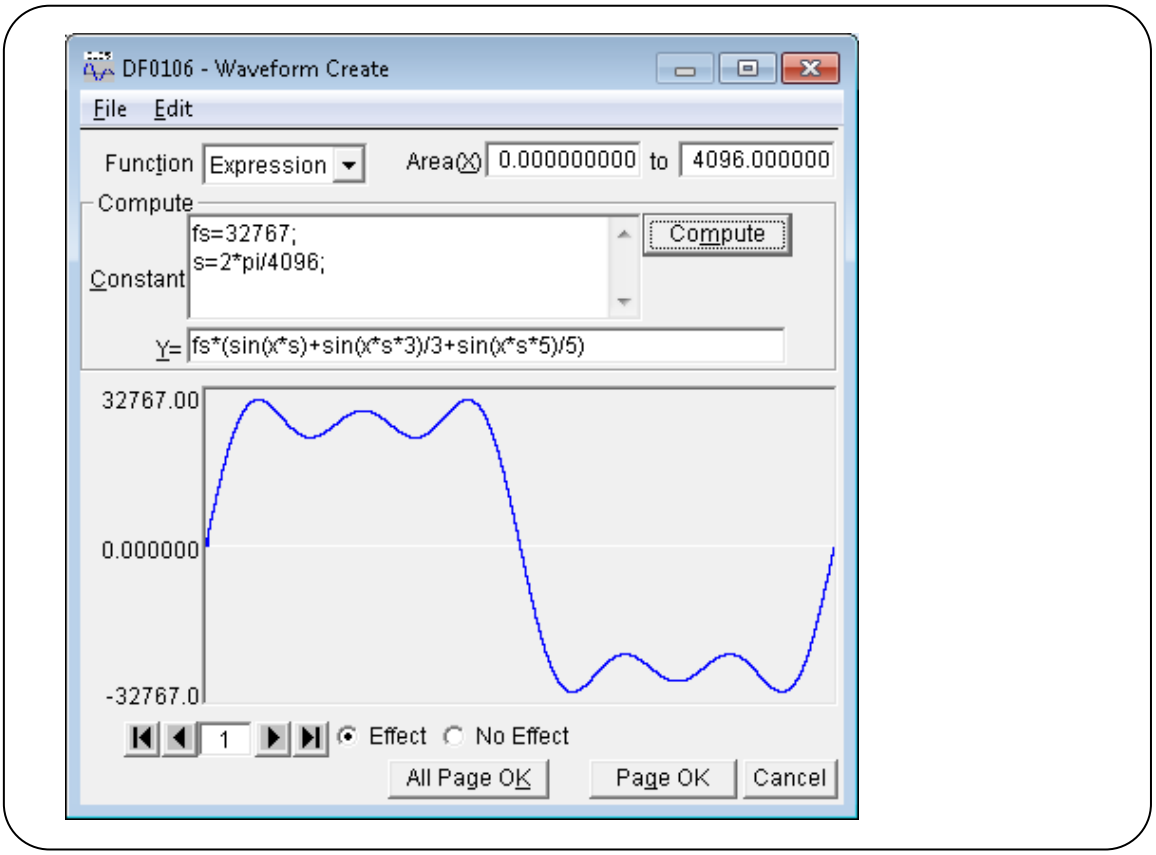


Figure 5-2 Waveform Generation screen – mathematical expression waveform

After entering the constants and expression, click Compute to check the resulting waveform on the Waveform Generation screen.

To create waveforms for all pages at once, click the All Pages OK button at the bottom of the screen.

To create only the waveform for the displayed page, 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

Constants are defined in the form [constant = value or expression], such as [fs=32767;] or [s=2*pi/4096;]. A semicolon [;] is always appended to the end of a constant definition or expression.

Constants and expressions are always expressed in 8-bit characters. Both upper- and lower-case letters can be used.

Constants are expressed as strings consisting of letters or numbers beginning with a letter.

Constants should use different strings from those in "Table 5-4 Built-In functions". Also, we

recommend using strings different from those in "Table 5-2 Built-In constants".
The All Pages OK button enables the constants for all subsequently defined pages.
For example, constants defined on the first page are valid on all pages. Constants defined on the third page are valid for all subsequent pages, but are invalid on the first and second pages.
When creating a waveform for only the displayed page with the Page OK button, constants are valid only on the displayed page. For example, constants defined on the second page are invalid on the first, third and subsequent pages.
In this case, to validate constants defined on another page, click the Compute button on the page where the constants are defined before executing calculation on the current page.

b) Built-In constants

The constants in "Table 5-2 Built-In constants" are predefined in DF0106.
If a constant is defined with the same name as the built-in constants in "a) Constants", the defined value or expression takes precedence.

Table 5-2 Built-In constants

Expression	Meaning	Value
Pi	Pi	3.1415926535898
c	the speed of light	2.99792458e8
h	Planck's constant	6.6260755e-34
k	Boltzmann's constant	1.380658e-23
r	Euler's constant	0.57721566490153

c) Functions

Enter the right part of Y=f(x) that expresses the relationship between X and Y into the [Y=] input area. Here, "X" is the variable within the page's range. For example, if the page's range is 1000 to 2000, [X] in the expression varies from 1000 to 2000.

The [X] value in the expression is affected by the units of the horizontal axis set on the System Settings screen.

➡ "5.5.5 Horizontal axis units"

For example, consider the formula such as [Y=] [sin(x)]. Here, the argument of the sin( ) function is a radian expression.
Consider when the horizontal axis unit is [Address], and the range is 0 to 4096. Because 4096＝2*π*651.8986..., this formula produces about 652 sine waves.
When the horizontal axis unit is [Time] and the period is 1 ms, because 1e-3＝2*π*0.0001591..., this formula produces an almost unchanged value of the sine wave around 0°.
When the vertical axis unit setting is [User unit] and set to 0 to 1, because 1＝2*π*0.1591..., this formula produces about 1/6th of the first half of the sine wave.
This simplest formula to obtain a single sine wave uses the horizontal axis [User unit] set to 0 to

6.283185.

The [Y=] value in the formula is affected by the units of the vertical axis set on the System Settings screen.

➡"5.5.6 Vertical axis units"

For example, consider the assignment of a sine wave formula such as [Y=] [sin(x)]. The value of the sin( ) function is ±1.

When the vertical axis unit is [Data] and the range is –32768 to +32767, this formula produces a very small amplitude waveform near zero.

When the vertical axis unit is [Voltage] and the amplitude is set to 10 Vp-p, the range is ±5, so this formula produces a 1/10th full-scale sine wave.

When the vertical axis unit setting is [User unit] set to –1 to +1, this formula produces a full-scale sine wave.

Calculation results that exceed ±full-scale cause the waveform to be clipped at ±full-scale.

d) Operators

The operators in "Table 5-3 Operators" can be used in the [Constant] and [Y=] formula input sections.

The highest priority operators are at the top of the table, and lowest priority at the bottom.

Logical operators return 1 when the condition is true, and 0 when false.

Table 5-3 Operators

Operator	Associativity	Remarks
(), Function, Constant, User-defined variable, Numerical string	→	
+ – !	←	Unary operators, ! is logical operator
^	→	Binary operator, exponential
* /	→	Binary operators, multiplication and division
+ –	→	Binary operators, addition and subtraction
< <= > >=	→	Logical operators, greater/less than
== !=	→	Logical operators, equality
&&	→	Logical operator, conjunction
||	→	Logical operator, disjunction

e) Built-In functions

Functions available for use in the [Y=] formula input section of DF0106 are listed in "Table 5-4 Built-In functions".

The argument of the triangle function is a radian expression.

The power( ) and phase( ) functions return complex vector size and polarization given the real part in expression 1 and the imaginary part in expression 2.

The tri( ) function defines a triangle wave given the angle in expression 1 and the slope in expression 2. Expression 2 can be omitted. When omitted, the slope is treated as 50%.

The sqw( ) function defines a square wave given the angle in expression 1, the duty cycle in expression 2, and the transition in expression 3. Expressions 2 and 3 can be omitted. When omitted, the duty cycle is treated as 50% and the transition is 0%. However, when expression 3 is specified, expression 2 cannot be omitted.

The rnd( ) function takes no argument, and serves to define noise.

Table 5-4 Built-In functions

sin(exp.)	cos(exp.)	tan(exp.)	atn(exp.)
sqr(exp.)	exp(exp.)	log(exp.)	
power(exp.1, exp.2)		phase(exp.1, exp.2)	
tri(exp.1, exp.2)	sqw(exp.1, exp.2, exp.3)		rnd()

f) Mathematical expression waveform examples

Following are several examples of mathematical expression waveform.

In these single-page examples, the range is the full range of the horizontal axis, and the description is omitted.

- Sine wave 1 cycle (horizontal units: Address 0 to 4096, vertical units: Data ±32767)
  Page 1 [Constant] [fs=32767;] [Y=] [fs*sin(x*s)]
  [s=2*pi/4096;] ← 4096 Address is 2π

- Sine wave 1 cycle (horizontal units: Time 0 to 1 ms, vertical units: Voltage ±10 V)
  Page 1 [Constant] [fs=10;] [Y=] [fs*sin(x*s)]
  [s=2*pi/1e-3;] ← 1 ms is 2π

- Sine wave 1 cycle (horizontal axis: User units 0 to 1, vertical axis: User units –1 to +1)
  Page 1 [Constant] [s=2*pi;] [Y=] [sin(x*s)]

- Sine wave 1 cycle (horizontal axis: User units 0 to 6.283185, vertical axis: User units –1 to +1)
  Page 1 [Constant] [none] [Y=] [sin(x)]

- Square wave 1 cycle (horizontal axis: User units 0 to 6.283185, vertical axis: User units –1 to +1)
  Page 1 [Constant] [none] [Y=] [((sin(x)>=0)-0.5)*2]
  (Logical operator ">=" obtains the square wave by converting 0/+1 to ±1.)

- DC sweep waveform (horizontal axis: User units 0 to 1, vertical axis: User units –1 to +1)
  Page 1 [Constant] [none] [Y=] [(x-0.5)+sin(2*pi*x*32)/2]

- Damped wave (horizontal axis: User units 0 to 6.283185, vertical axis: User units –1 to +1)
  Page 1 [Constant] [none] [Y=] [exp(-x)*sin(x*64)]

- DSB waveform (horizontal axis: User units 0 to 6.283185, vertical axis: User units –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 units 0 to 1, vertical axis: User units –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)]

- Differential waveform (horizontal axis: User units 0 to 1, vertical axis: User units –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] [none] [Y=] [-exp(-(x-0.5)*j)]

- Magnetic head waveform: Gaussian pulse (horizontal axis: User units -1 to 1, vertical axis: User units –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] [none] [Y=] [-exp(-((x-0.5)^2)*j)]

- Magnetic head waveform: Lorentz waveform (horizontal axis: User units 0 to 6.283185, vertical axis: User units –1 to +1)
  Page 1 [Constant] [none] [Y=] [(sin(x)-sin(x*3)/3+sin(x*5)/5)/1.533333333]

- Waveform surge superimposed around 180° (horizontal axis: User units 0 to 1, vertical axis: User units –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]
  (After creating the sine wave in the whole range of page 1, overwrite with the surge waveform on page 2.)

- Sin(X)/X waveform (horizontal units: Address 0 to 4096, vertical units: Data ±32767)

Page 1	[Area(X)]	[0] to [2048]	
	[Constant]	[fs=32767;]	[Y=] [fs*sin((x-s)/k)/((x-s)/k)]
		[s=2048;]	
		[k=174;]	
Page 2	[Area(X)]	[2048] to [2049]	
	[Constant]	[none]	[Y=] [32767]
Page 3	[Area(X)]	[2049] to [4096]	
	[Constant]	[none]	[Y=] [fs*sin((x-s)/k)/((x-s)/k)]

5.1.5 File operations

Waveform Generation screen settings can be saved to a text file.
On the Waveform Generation screen, click [File] – [Save] (or press Alt, F, S or Ctrl + S) to display the [Save as] screen.
Select a save location, enter a file name, and click the Save button. The ".wfn" file extension is automatically applied and may be omitted when entering the file name.

To load a Waveform Generation screen settings file, click [File] – [Open] (or press Alt, F, O or Ctrl + O).
The [Open file] screen appears, where you can select the file location, enter the file name, and click the Open button.

Although the Waveform Generation screen settings file is an editable text file, we recommend avoiding direct editing.
It may become unloadable by DF0106, or exceed length limitations that can make it impossible to load normally.

Other DF0106-supported file types ➡ "4.7.1 Types of Files"

5.1.6 Printing

The setting status of the Waveform Generation screen can be printed out.
On the Waveform Generation screen, click [File] – [Print] (or press Alt, F, P or Ctrl + P) to display the [DF0106 - Print] screen.
Set the top, bottom and left margins, printer and font settings as needed, then click the OK button.

5.2 Waveform Compression/Expansion

On the Compression/Expansion screen you can vertically and horizontally compress and expand the selected area of a waveform.

Click the button on the toolbar or click [Tools] – [Compress/Decompress] (or press Alt, T, P to open the Compression/Expansion screen.

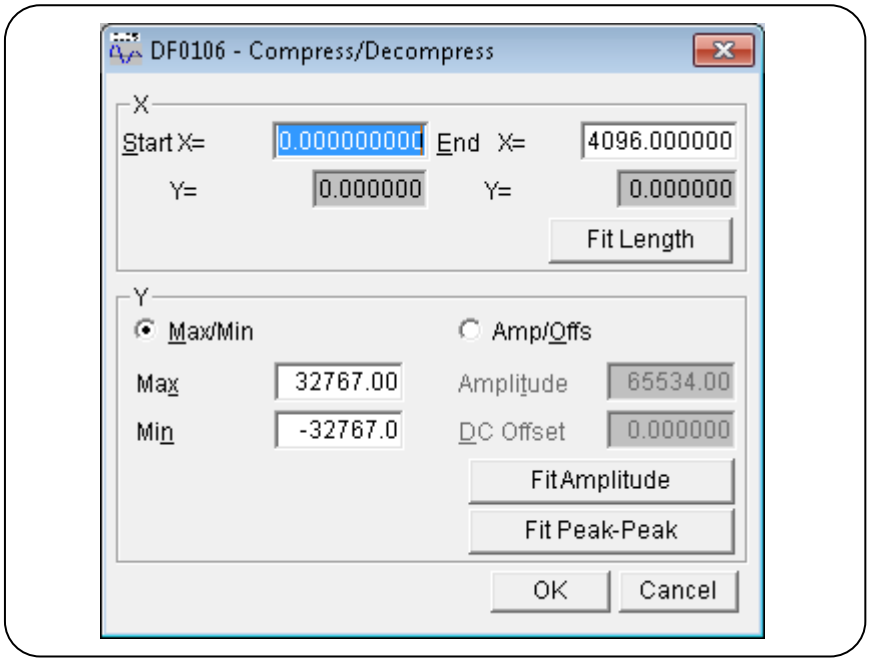


Figure 5-3 Compression/Expansion screen

To revert to the previous waveform immediately after returning to the waveform display screen with the waveform reformed by the Compression/Expansion screen, click [Edit] - [Undo] (or press Alt, E, U), or Ctrl + U.

➡"4.4 Undoing and Redoing"

5.2.1 Horizontal axis compression/expansion

Select the range using the markers on the waveform display screen before compressing/expanding the horizontal axis.

➡ "4.6.2 Selecting Range"

Compression/expansion of the horizontal axis is set by the [X] range settings on the Compression/Expansion screen.

a) Compressing/expanding the selected range to start and end points.

Enter numerical values for the [Start X=], and [End X=], then click the OK button.

The range selected by the markers beforehand can be compressed, expanded or moved to a specific region by the start/end points.

The region the data of which become lost by compression/expansion will be padded with the values just before or after the markers.

b) Expanding the selection to the whole range

Click the Fit Length button to expand the portion selected by the markers beforehand to the whole waveform range.

Actual data collected by a digital oscilloscope is almost never exactly one period. In this case, this function can be used to extract exactly one period.

c) Others

Be aware that excessive expansion can distort the waveform.

5.2.2 Vertical axis compression/expansion

Compression and expansion of the vertical axis is performed with the selected range.
Select the range using the markers on the waveform display screen before compressing/expanding the vertical axis.

➡ "4.6.2 Selecting Range"

Compression/expansion of the vertical axis is set by the [Y] range settings on the Compression/Expansion screen.

a) Specifying maximum/minimum values for compression/expansion

When the [◯Max/Min] option button (◯) is selected (◉), the [Max] and [Min] values of the range selected by the markers are displayed.
Enter the target maximum and minimum values to be displayed after compression/expansion into the displayed boxes, and press the Enter key to change the waveform on the waveform display screen.
Move the Compression/Expansion screen if it obstructs the displayed waveform.
Setting the maximum value less than the minimum value vertically inverts the waveform.
When the desired waveform is obtained, click the OK button.
To return to the waveform display screen without applying compression/expansion, click the Cancel button or press the Esc key.

b) Specifying amplitude/offset for compression/expansion

When the [◯Amp/Offs] option button (◯) is selected (◉), the amplitude value of the range selected by the markers is displayed as [Amplitude] and Offset [DC Offset].
Amplitude/offset and max/min values are related as follows.

$$\text{amplitude} = (\text{max value} - \text{min value}),\ \text{offset} = \frac{\text{max value} + \text{min value}}{2}$$

$$\text{max value} = \text{offset} + (\text{amplitude} \div 2),\ \text{min value} = \text{offset} - (\text{amplitude} \div 2)$$

After executing compression/expansion, enter target amplitude/offset values into their respective displayed boxes, then click the OK button.
Setting the amplitude to a negative value vertically inverts the waveform.

c) Expanding the selected area to maximum amplitude

Click the Fit Peak-Peak button to expand the portion selected by the markers beforehand to maximum amplitude. If the offset of the selected portion is non-zero before expansion, it is reset to zero when expanded.
When you click the Fit Amplitude button without changing the offset, expansion is executed with positive and negative peaks at maximum values.

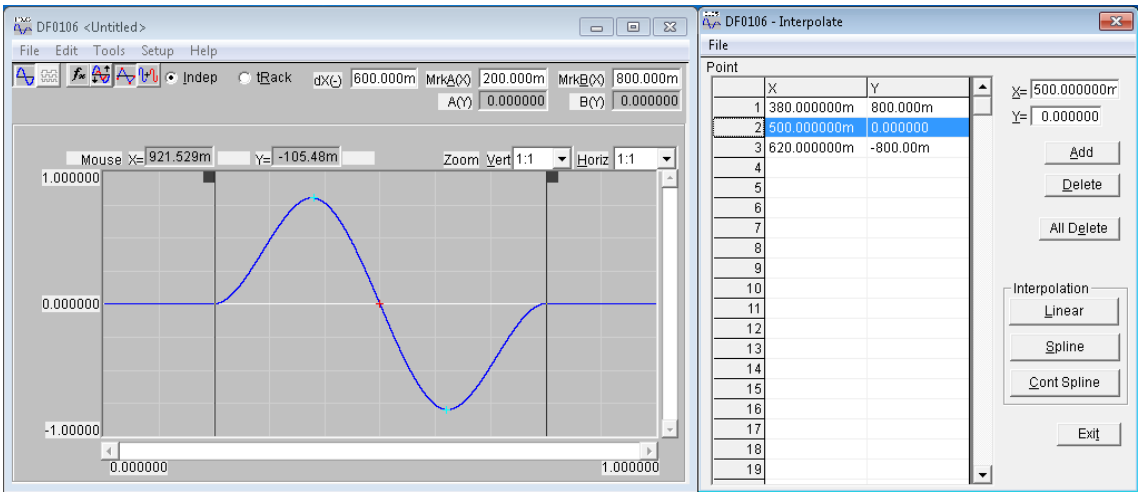
d) Others

Expansion results that exceed ±full-scale cause the waveform to be clipped at ±full-scale.
Be aware that excessive expansion can distort the waveform.

5.3 Waveform Generation through Interpolation

On the Interpolation Editing screen, waveforms can be created from various interpolations. A "point" set for interpolation is called a "control point".

Click the button on the toolbar or click [Tools] – [Interpolate] (or press Alt, T, I to open the Interpolation Editing screen.



(Waveform Display Screen) Interpolation Editing Screen

Figure 5-4 Interpolation Editing screen

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

5.3.1 Control point settings

Interpolation is executed over the range selected by the markers on the waveform display screen. Although control points can be set outside of the selected range, they are ignored when interpolation is executed.

a) Specifying control points by numerical values

Enter numerical values in the [X=] and [Y=] input boxes on the Interpolation Editing screen.
To activate the[X=] input box, click it or press Alt + X.
To activate the[Y=] input box, click it or press Alt + Y.
Clicking the Add button displays a [+] mark at the specified location on the waveform display screen. The numerical values of the control point location are also displayed in the control point table on the Interpolation Editing screen. Control point table entries are sorted in order of ascending X values.

b) Specifying control points by mouse

If any control point [+] marks appear in red (selected), first click in an unmarked place in the waveform display area so that all marks are light blue (unselected).
Now move the mouse to the location of the desired control point, and click while pressing the Ctrl key to add it. The newly added control point is displayed in red, indicating its selected state.

c) Moving an interpolation control point by numerical value

In the table on the Interpolation Editing screen, click any control point so that it appears as follows.

- The specified point in the table is displayed in reverse.
- The [X=] and [Y=] numerical input boxes show the selected control point location.
- The corresponding [+] mark on the waveform display screen is displayed in red.

You can also select a control point just by clicking its [+] mark on the waveform display screen. However, if the magnification factor is low, the mark may be hard to select due to display resolution.
With the control point selected, enter the new numerical values in [X=] and [Y=] input boxes, and click the Add button to move the selected control point.

d) Moving a control point by mouse

A control point can be moved by dragging its [+] mark on the waveform display screen. However, if the magnification factor is low, the mark may be hard to select due to display resolution.

e) Deleting a control point

Clicking the Delete button deletes the currently selected control point.
There is no way to recover deleted control points, so be careful when using this function.

f) Deleting all control points

Clicking the All Delete button deletes all set control points.
There is no way to recover the deleted control points, so use this function very carefully.

5.3.2 Interpolation execution

Execute interpolation after selecting the range and setting the control points. The following three interpolation methods are available.

- Straight-line interpolation interpolates with straight lines between control points.
- Spline interpolation interpolates with smooth curves between control points.
- Continuous spline interpolation interpolates with curves continuous with the waveform outside of the selected range.

To execute straight-line interpolation, click the Linear button or press Alt + L.
To execute spline interpolation, click the Spline button or press Alt + S.
To execute continuous spline interpolation, click the Cont Spline button or press Alt + C.

When a portion of a waveform is a within the selected range, interpolation is applied to both ends of the range and to the control points within the range.
When the whole waveform is selected, a continuous spline joins the waveform cycles smoothly when the cycle repeats. With straight-line and spline interpolation, the first and last values are changed, resulting in discontinuous connection if the cycle repeats.

Interpolation results that exceed ±full-scale cause the waveform to be clipped at ±full-scale.

After executing interpolation, click the OK button to return to the waveform display screen.
To revert to the previous waveform immediately after returning to the waveform display screen with the waveform created by the Interpolation Editing screen, click [Edit] – [Undo] (or press Alt, E, U), or Ctrl + U.

5.3.3 File operations

Interpolation Editing screen settings can be saved to a text file.
On the Interpolation Editing screen, click [File] – [Save] (or press Alt, F, S or Ctrl + S) to display the [Save as] screen.
Select a save location, enter a file name, and click the Save button. Select a file extension from ".prn", ".tsv" or ".csv" so that it may be omitted when entering the file name.

To load an Interpolation Editing screen settings file, click [File] – [Open] (or press Alt, F, O or Ctrl + O).
The [Open file] screen appears, where you can select the file location, enter the file name, and click the Open button.

The file can be read as is with a text editor or spreadsheet software. A text file can be also being created with a text editor or spreadsheet software to be loaded by DF0106. When creating the text file, make sure that each line consists of two data values: one X and one Y.

Other DF0106-supported file types ➡ "4.7.1 Types of Files"

5.4 Operate between Waveforms

On the Operation screen you can create a new waveform by applying four arithmetic operations to a selected waveform range, standard waveform, numerical waveform or clipboard waveform.
Click the button on the toolbar or click [Tools] – [Operate] (or press Alt, T, O to open the Operation screen.

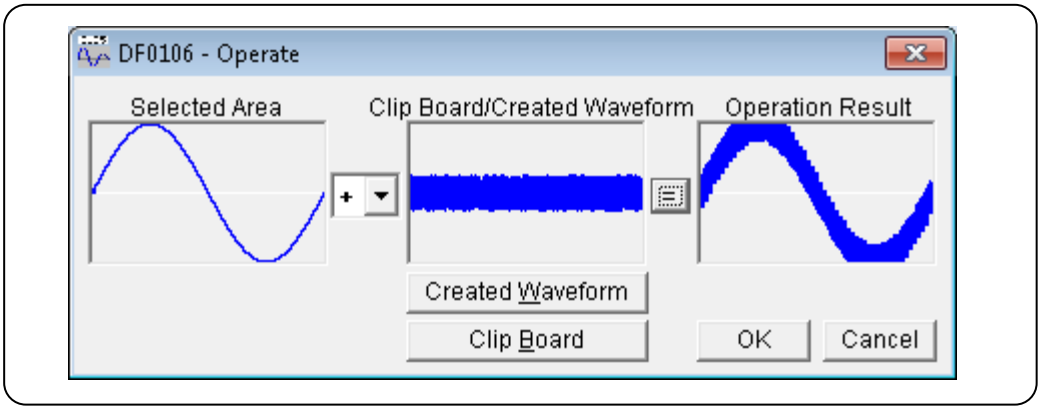


Figure 5-5 Operation screen

Immediately after creating a waveform on the Operation screen, you can revert to the previous waveform: click [Edit] – [Undo] (or press Alt, E, U), or Ctrl + U.
Operations are executed over the selected range. Select the range beforehand with the A and B markers on the waveform display screen.

5.4.1 Operation types

Click the button to the right of [+] to view a list of the four arithmetic operators: +, –, * and /.
Click within the list or press the ↑ ↓ → ← keys to select an operator.
[*] denotes multiplication (×), and [/] denottes division(÷).

5.4.2 Object of Operation

a) Generation waveform

Click the Created Waveform button or press Alt + W to display the Generation Waveform screen. However, at this time there are the following limitations.

- [Area(X)] and [Size] cannot be changed.
- The range is not allowed to span multiple pages.

When a waveform has been created by "5.1 Standard and Mathematical expression waveform generation" and you click the Page OK button, it is displayed in [Clip Board/Created Waveform] area.

b) Clipboard

Click the Clip Board button or press Alt + B to display the waveform stored in the [Clip Board/Created Waveform] area. Clipboard ➡ "4.8.2 Clipboard"

If the selected range extends beyond the clipboard, the tail of the waveform is handled as zero data.

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

Clipboard contents are 16-bit integers (–32768 to +32767), but for operations, they are converted to the current vertical axis units. For example, when the vertical axis has User units –1 to +1, clipboard values ±32767 are handled as ±1.

5.4.3 Operation execution

Clicking the = button displays operation results at [Operation Result].

Click the OK button to return to the waveform display screen with the calculation results reflected.

To return to the waveform display screen without any changes, click the Cancel button or press the Esc key.

For operations, and especially for multiplication, we recommend using vertical axis User units –1 to +1. By performing operations in this way, multiplication results between ±full-scale values can be made ±full-scale.

Calculation results that exceed ±full-scale cause the waveform to be clipped at ±full-scale.

Division by zero produces an infinite value, which is normally an error. However, as a special case to avoid errors in operations, the result of division by zero is set to zero.

5.5 Waveform and settings transfer

The System Settings screen shows the signal generator model, interface and major parameter settings. It also supports transferring signal generator settings and waveform data to the signal generator.
The System Settings screen also provides setting of the vertical and horizontal units for the waveform display screen.

Click [Setup] – [Setup] (or press Alt, S, S) to open the System Settings screen.

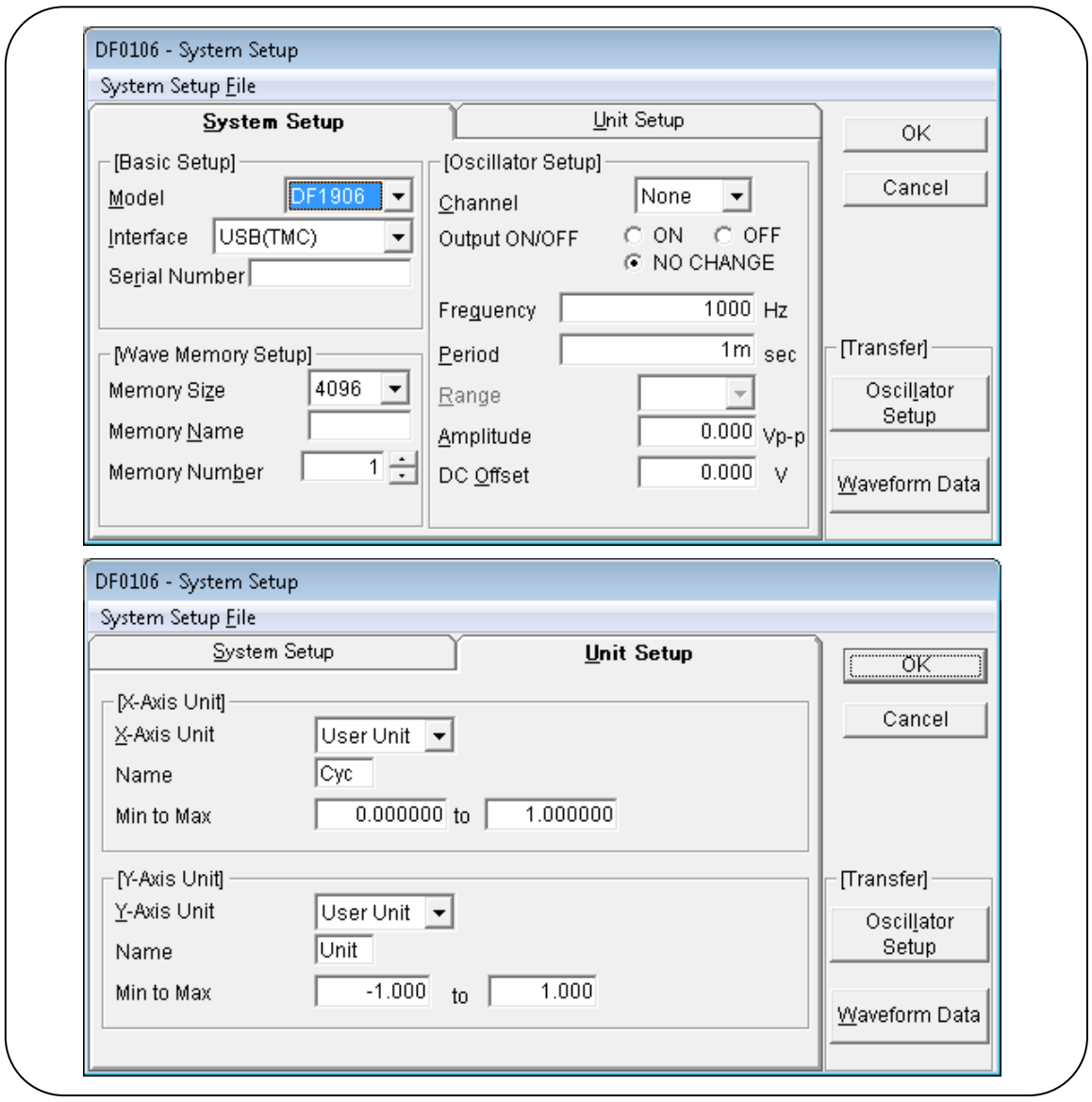


Figure 5-6 System settings screen

The System Setting screen has two page tabs: [Setup] and [Unit Setup].
Click the [Setup] tab or press Alt + S to display the [Setup] page.
Click the [Unit Setup] tab or press Alt + U to display the [Unit Setup] page.

5.5.1 Model settings

In the [Basic Setup] area on the [Setup] page, signal generator model selection, interface selection and the serial number setting are available.

a) Target model selection

Click the ▼ button to the right of [Model] to see a list of compatible signal generator models.

Click within the list or press the ↑ ↓ → ← keys to select the applicable model.

Setting items and configurable ranges in the [Wave Memory Setup] and [Oscillator Setup] areas change depending on model selection.

The model selection is retained even when DF0106 is closed, so the same model is selected when the program is started again later.

b) Interface selection

Click the ▼ button to the right of [Interface] to see a list of compatible interfaces.

Click within the list or press the ↑ ↓ → ← keys to select the applicable interface.

The interface selection is retained even when DF0106 is closed, so the same interface is selected when the program is started again later.

c) Serial number setting

When the [Interface] selection is USB(TMC), the serial number can be entered.

Enter the serial number of the signal generator to be connected in the [Serial Number] text input box.

The serial number entries consist of the capital letters "SN" followed by seven digits.

Entry Example: **SN0123456**

The serial number of your device can be displayed by pressing the "SPECIAL" key several times.

Display Example: **<CONT> SERIAL SN0123456**

5.5.2 Waveform memory settings

In the [Wave Memory Setup] area on the [Setup] page, waveform memory size, name and number settings are available. Depending on the signal generator model, some items cannot be set.

a) Waveform memory size

Click the ▼ button to the right of [Memory Size] to see the waveform memory size list.

Click within the list or press the ↑ ↓ → ← keys to select a size.

The waveform memory size selection is retained even when DF 0106 is closed, so the same model is selected when the program is started again later.

b) Waveform memory name

Enter the waveform memory name in the [Memory Name] text box.

The waveform memory name cannot be entered with DF 1906.

c) Waveform memory number

Click the ▲▼ selector buttons to the right of [Memory Number] to select the number of the waveform memory.

Click ▲ to increment and ▼ to decrement the number.

You can also enter the number directly in the numerical entry box.

5.5.3 Signal generator settings

In the [Oscillator Setup] area of the [Setup] page, the signal generator channel, output on/off, frequency (period), output range, amplitude and DC offset can be set.
Frequency, period, amplitude and DC offset numerical entries may be followed by T (10^{+12}), G (10^{+9}), M (10^{+6}), k (10^{+3}), m (10^{-3}), u (10^{-6}: μ), n (10^{-9}), p (10^{-12}), f (10^{-15}), a (10^{-18}).
Signal generator settings are initialized when exiting DF0106 and reloaded the next time or it is restarted.

a) Channel

Click the ▼ button to the right of [Channel] to view a list of selectable channels.
Click within the list or press the ↑ ↓ → ← keys to select a channel.

b) Output on/off

Select one of the option buttons ([ON], [OFF] or [NO CHANGE]) to the right of [Output ON/OFF] for the desired output state.
When NO CHANGE is selected, the on/off state doesn't change when you press the Oscillator Setup button.

c) Frequency

The [Frequency] input box is enabled when clicked, or by pressing Alt + Q. Enter a numerical value in this state, and press the Enter key to accept the value.
Changing the frequency setting updates the period (inverse frequency value).
Setting the frequency above the practical upper limit of an arbitrary waveform causes a warning message to appear.
The practical upper limit of an arbitrary waveform and frequency range setting depend on the signal generator.

d) Period

The [Period] input box is enabled when clicked, or by pressing Alt + P. Enter a numerical value in this state, and press the Enter key to accept the value.
Changing the period setting updates the displayed frequency.
Setting the frequency above the practical upper limit of an arbitrary waveform causes a warning message to appear.
The practical upper limit of an arbitrary waveform and period range setting depend on the signal generator.

e) Output range

Click the ▼ to the right of [Range] to view a list of selectable output ranges.
Click within the list or press the ↑ ↓ → ← keys to select the output range.

f) Amplitude

The [Amplitude] input box is enabled when clicked, or by pressing Alt + A. Enter a numerical value in this state, and press the Enter key to accept the value.

The output range determines the settable amplitude range.

In addition, because amplitude and DC offset are mutually constrained, an error may occur when signal generator settings are transferred by USB. Refer to the signal generator's instruction manual to determine settings that do not produce an error.

g) DC offset

The [DC Offset] input box is enabled when clicked, or by pressing Alt + O. Enter a numerical value in this state, and press the Enter key to accept the value.

The output range determines the settable DC offset range.

In addition, because amplitude and DC offset are mutually constrained, an error may occur when signal generator settings are transferred by USB. Refer to the signal generator's instruction manual to determine settings that do not produce an error.

5.5.4 Transfer execution

a) Transfer execution

Click the Oscillator Setup button or press Alt + L to transfer the [Oscillator Setup] to the signal generator.

Click the Waveform Data button or press Alt + W to transfer the created waveform data to the signal generator.

b) Notes about USB

- Transfer cannot be executed if the driver software is not correctly installed.

➡ "2.2.1 Installing USB Driver Software"

- Do not operate DF0106 during transfer.
- An error occurs of the serial number does not match the connected signal generator. Check the setting.
- Simultaneous transfers from multiple DF0106 instances are prohibited.

5.5.5 Horizontal axis units

Beside waveform data address, DF0106 allows time and user units to serve as horizontal display/setting units.

Time is linked to the [Frequency] and [Period] [Oscillator Setup].
The waveform span from beginning to end, that is one period, corresponds to [Period] in the [Oscillator Setup].
This function is useful, for example, for waveform interpolation with voltage on the vertical axis and time on the horizontal axis.

With User units, the beginning and end of waveform data can be optionally assigned, and an optional unit name can be set.
See "Table 5-5 Example horizontal axis user units".
When creating waveforms with mathematical expressions, radian units are used for trigonometric functions such a sin(), so the range 0 to 6.283185 is useful.

On the System Settings screen, click the [Unit Setup] tab or press Alt + U to display the [Unit Setup] page.
Click the ▼ button to the right of [X-Axis Unit] to view a list of selectable horizontal axis units.
Click within the list or press the ↑ ↓ → ← keys to select the desired horizontal axis units.
When User units are selected for the horizontal axis units, [Name] and [Min to Max] can be set.
Enter up to four characters in 8bit for the horizontal axis unit [Name].
For [Min to Max], enter the numerical values for the left and right ends of the waveform, respectively.

Table 5-5 Example horizontal axis user units

Range	Name (Comment)
0 to 1	Period
–1 to 1	(Vertical axis user units: when used with ±1, use to match the vertical axis range)
0 to 360	degrees (°)
0 to 400	grad
0 to 6.283185	rad

5.5.6 Vertical axis units

Beside waveform data (16 bits: –32768 to +32767), DF0106 allows voltage and user units to be used for vertical display/setting units.

Voltage is linked to [Amplitude] and [DC Offset] [Oscillator Setup].
This function is useful, for example, for waveform interpolation with voltage on the vertical axis and time on the horizontal axis.

With User units, the lower and upper limits of waveform data can be optionally assigned, and an optional unit name can be set.
When creating waveforms with mathematical expressions, the maximum sin() value is ±1, so the -1 to +1 range is useful.

On the System Settings screen, click the [Unit Setup] tab or press Alt + U to display the [Unit Setup] page.
Click the ▼ button to the right of [Y-Axis Unit] to view a list of selectable vertical axis units.
Click within the list or press the ↑ ↓ → ← keys to select the desired vertical axis units.
When User units are selected for the vertical axis units, [Name] and [Min to Max] can be set.
Enter up to four characters in 8-bit for the horizontal axis unit [Name].
For [Min to Max], enter the numerical values for the lower and upper limits of the waveform, respectively.

5.5.7 File operations

Settings on the System Settings screen can be stored in and read from files.
DF0106 system settings files are in a custom binary format, not usable elsewhere.

On the System Settings screen, click [System Setup File] – [Save] (or press Alt, F, S or Ctrl + S) to display the [Save as] screen.
Select a save location, enter a file name, and click the Save button. The ".ocb" file extension is automatically applied and may be omitted when entering the file name.

To load a System Settings file, click [System Setup File] – [Open] (or press Alt, F, O or Ctrl + O).
The [Open file] screen appears, where you can select the file location, enter the file name, and click the Open button.

Other file types that can be handled by DF0106 ➡ "4.7.1 Types of Files"

5.5.8 Printing

The setting status of the System Settings screen can be printed out.
Click [System Setup File] – [Print] (or press Alt, F, P or Ctrl + P) to display the [DF0106 - Print] screen.
Set the top, bottom and left margins, printer and font settings as needed, then click the OK button.

5.5.9 Version check

Click [Help] – [About] to display the version information.

5.5.10 Initial settings

Of the parameters set on the System Settings screen, those initialized when starting DF0106 are shown in "Table 5-6 Initial value list".

Table 5-6 Initial value list

Waveform memory name	—
Waveform memory number	1
Channel	—
Output On/Off	NO CHANGE
Frequency [Hz]	1000
Period [sec]	1m
Output Range	—
Amplitude [Vp-p]	0
DC offset [V]	0.000
DC ON/OFF	—
X-Axis units	Address
X-Axis name	(not specified)
X-Axis minimum value	0.000000
X-Axis maximum value	1.000000
Y-Axis units	Data
Y-Axis name	(not specified)
Y-Axis minimum value	-1.000
Y-Axis maximum value	1.000

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DF 0106 INSTRUCTION MANUAL

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