EC1000S

AC and DC Power Source

Signal/Power Source Control

Software Manual

AMETEK PROGRAMMABLE POWER

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Date and Revision

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Important Safety Instructions

Before applying power to the system, verify that your product is configured properly for your particular application.

WARNING	**Hazardous voltages may be present when covers are removed. Qualified personnel must use extreme caution when servicing this equipment. Circuit boards, test points, and output voltages also may be floating above (below) chassis ground.**
WARNING	**The equipment used contains ESD sensitive ports. When installing equipment, follow ESD Safety Procedures. Electrostatic discharges might cause damage to the equipment.**

Only *qualified personnel* who deal with attendant hazards in power supplies, are allowed to perform installation and servicing.

Ensure that the AC power line ground is connected properly to the Power Rack input connector or chassis. Similarly, other power ground lines including those to application and maintenance equipment *must* be grounded properly for both personnel and equipment safety.

Always ensure that facility AC input power is de-energized prior to connecting or disconnecting any cable.

In normal operation, the operator does not have access to hazardous voltages within the chassis. However, depending on the user's application configuration, **HIGH VOLTAGES HAZARDOUS TO HUMAN SAFETY** may be normally generated on the output terminals. The customer/user must ensure that the output power lines are labeled properly as to the safety hazards and that any inadvertent contact with hazardous voltages is eliminated.

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SAFETY SYMBOLS

WARNING Risk of Electrical Shock	CAUTION Refer to Accompanying Documents
Off (Supply)	Direct Current (DC)
Standby (Supply)	~ Alternating Current (AC)
On (Supply)	3~ Three–Phase Alternating Current
Protective Conductor Terminal	Earth (Ground) Terminal
Fuse	Chassis Ground

Product Family: EC1000S

Warranty Period: One Year

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     Telephone: 800-733-5427, ext. 2295 or ext. 2463 (toll free North America)
     858-450-0085, ext. 2295 or ext. 2463 (direct)
   - **Outside the United States**, contact the nearest Authorized Service Center (ASC). A full listing can be found either through your local distributor or our website, www.programmablepower.com, by clicking Support and going to the Service Centers tab.
2. When requesting an RMA, have the following information ready:
   - Model number
   - Serial number
   - Description of the problem

NOTE: Unauthorized returns will not be accepted and will be returned at the shipper's expense.

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— Preface —

Thank you for purchasing the **EC1000S Programmable AC/DC Power Source.**

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

■ Before Reading This Manual

This manual is a PDF file stored on the CD-ROM (P/N CIC496, filename: EC1000S_SPSC_Manual_4994-975.pdf which is distributed with the EC100S Programmable AC/DC Power Source). Acrobat Reader (Adobe Systems, Inc.) Ver. 5 or higher is required to view the file contents.

This manual is intended for users with knowledge for basic operation of the operating system (OS) (Microsoft Windows 2000/XP/Vista) to be used. For basic operation of the Windows OS or definitions of terms such as "click" and "drag", see the user's guide of the Windows OS.

Figures or messages shown in this manual are for the Windows 2000 environment, and may differ in other environments.

■ Caution Symbols Used in This Manual

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

⚠ **CAUTION**

This mark indicates cautions on handling of this program.

- **This manual has the following chapter organization.**
  If you are reading this manual for the first time, start from **1. OVERVIEW**.

1. OVERVIEW
   Presents brief descriptions of the SPSC Remote Control Software functions.
2. INSTALLATION and 3. LAUNCHER
   Describes environmental requirements for operation of the **SPSC Remote Control Software** as well as its installation and startup procedures.
4. REMOTE CONTROL and 5. LOGGING
   Describes the operation procedures for remote control and logging.

6. OVERVIEW OF ARBITRARY WAVEFORM CREATION to 8. ARBITRARY WAVEFORM – OTHER SCREEN OPERATIONS
   Describes the operation procedures for creating an arbitrary waveform.

9. SEQUENCE EDITING to 11. OTHER SCREEN OPERATIONS FOR SEQUENCE EDITING
   Describes sequence editing.

12. ERROR MESSAGES
    Describes error specifications.

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

Contents

Figures and Tables

1. OVERVIEW

1.1 General

The **SPSC Signal/Power Source Control Software** is a program that supports remote control of Programmable AC/DC Power Source EC1000S, an arbitrary wave function and a sequence function.
This software runs under the Windows 2000 and XP operating systems in a personal computer (PC), and controls transfer of control data, arbitrary waveform data, and sequence data on the Programmable AC/DC Power Source EC1000S via a USB interface and execution of other operations.
The following are the main functions of this software:

- Remotely controlling the Programmable AC/DC Power Source EC1000S
- Monitoring the status of the Programmable AC/DC Power Source EC1000S
- Logging measurement values for the Programmable AC/DC Power Source EC1000S

- Creating, editing, and saving arbitrary waveform data
- Transferring arbitrary waveform data to the Programmable AC/DC Power Source EC1000S

- Creating, editing, and saving sequence data
- Transferring sequence data to the Programmable AC/DC Power Source EC1000S
- Previewing sequence data
- Controlling the sequence run by the Programmable AC/DC Power Source EC1000S
- Displaying the progress of the currently running sequence on the monitor

For operation details of the sequence function, **see the Programmable AC/DC Power Source EC1000S User Manual**.

1.2 Organization of Product

The following shows the organization of **SPSC Signal/Power Source Control Software**:

- Getting Started (Manual) ············ 1
- CD-ROM disk, which contains the SPSC software and an instruction manual ············ 1

1.3 Software Configuration

The **SPSC Signal/Power Source Control Software** consists of a **launcher** and **subsoftware** launched from the launcher.

There are the following three types of **subsoftware**.

Remote Control Software	(abbreviated as SPSC RMT)
Arbitrary Waveform Editor	(abbreviated as SPSC ARB)
Sequence Edit Software	(abbreviated as SPSC SEQ)

⚠ **Caution**

Only one subsoftware application can be run from the launcher at a time.
While a subsoftware application is running, other subsoftware applications cannot be started.

1.4 Online/Offline

The Remote Control Software and Sequence Edit Software check for connected devices at startup.
If a specified device is connected, the software starts in the "**online**" status where devices can be controlled.
If the specified device is not connected, the software starts in the "**offline**" status and does not communicate with any device. It is possible to create a device setting file or edit sequence data even in the "offline" status.

If the software starts in the offline status, make settings for the device to be connected, using each subsoftware.

Remote Control Software ☞ **See "4.9 System Setup".**
Sequence Edit Software ☞ **See "11.7 System Settings"**.

1.5 Conventions

The following conventions are used in this manual.

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

  Examples: **[Waveform(T)]**, **[s=2*pi;]**

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

  Examples: Cancel, OK, Alt

- Press one key while holding down another key: Two keys are connected by a plus (+) symbol.
  Example: Ctrl + O

- Press one key, release it and press another key: Two keys are divided by a comma (,).
  Example: Alt, F

2. INSTALLATION

2.1 Hardware Requirements

Before installing the **SPSC Signal/Power Source Control Software**, check that the system satisfies all the requirements below.

2.1.1 Personal computer

- CPU: 300 MHz or faster (1 GHz or faster recommended)
- Memory: 256 MB or more (512 MB or more recommended)
- Free hard disk space: 50 MB or more
- Display: 1024 × 768 pixels or higher and 256 colors or more.
- OS: Windows 2000 or XP (Microsoft)
- Disk drive: CD-ROM drive

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⚠ **CAUTION**

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

2.1.2 USB interface

- USB1.1 Full Speed

2.2 Installation Procedure

When installing or uninstalling the software in a Windows 2000 or XP environment, log on as a user who has an administrator privilege with a user name comprising 1-byte characters.

2.2.1 Installing the USB driver software

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

1. Search for the VISA Run-time Engine page on the National Instruments Corporation website or select "VISA driver downloads" at the following URL.
   http://www.ni.com/support/visa/

2. Download VISA Run-time Engine from the VISA Run-time Engine page.
   User registration must be performed at this time. Download VISA Run-time Engine Ver. 3.3 or later.

3. The downloaded file is a self-extracting file. Extract it and install the software.

4. The USB driver software is installed when installation is successfully complete.

For details, visit the National Instruments Corporation website.

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

a) Make sure that the device and the PC are not connected.

b) Power-on the device and connect the device and the PC using a USB cable.

c) The installation process starts automatically. Follow the guidance.

Note: The driver software must be installed for the GUI to work.

2.2.2 Installing SPSC

(a) Insert the **CIC496** CD-ROM into the CD-ROM drive of the PC.

(b) Execute **[Win32\GUI\SPSC\Setup.exe]** on the CD-ROM or **[D:\Win32\GUI\SPSC\Setup.exe]** from **[Run]** on the start menu.
[D:] indicates the CD-ROM drive. If another drive letter is assigned to the CD-ROM driver, assign it appropriately, according to your system.

(c) Click the Next button, following the screen guidance to start installation.

(d) When installation has been completed, the "**CI Signal/Power Source Control Software**" can be executed.
Click **[CI SPSC]** from Start - **[Programs] - [California Instruments] - [CI SPSC]** to execute the software.

2.2.3 Uninstalling SPSC

To remove the Signal/Power Source Control Software, first double-click **[Add/Remove Programs]** from the control panel. Next, click the **[CI Signal/Power Source Control Software]** and the Change/Remove button. Note that the folder in which the **CI Signal/Power Source Control Software** was installed may not be removed in some cases. All the files created in the folder remain as they are. If the folder is unnecessary, delete it after uninstallation.

3. LAUNCHER

3.1 Starting the Launcher

Click **[CI SPSC]** from Start - **[Programs] - [California Instruments] - [CI SPSC]** to start the launcher.

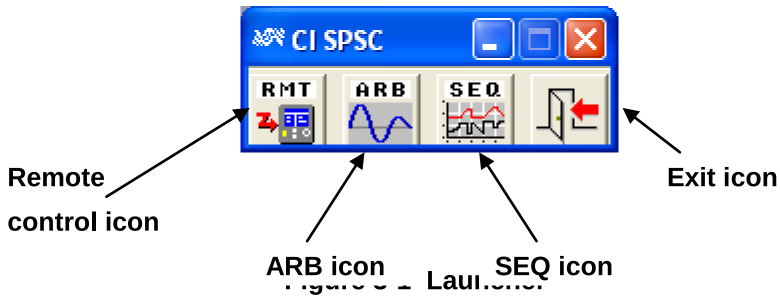


Figure 3-1 Launcher

a) Remote control icon

Starts the Remote Control Software.

b) ARB icon

Starts the Arbitrary Waveform Editor.

c) SEQ icon

Starts the Sequence Edit Software.

d) Exit icon

Exits the launcher.

3.2 Starting the Subsoftware

When you click the subsoftware icon button on the launcher screen, the subsoftware starts up. However, note that only one of the above subsoftware applications can be started. It is not possible to run multiple subsoftware applications.

When the subsoftware is started from the launcher, the launcher will be minimized. Even after the started subsoftware is exited, the launcher remains minimized.

Remote Control Software	☞ **See "4 REMOTE CONTROL" and subsequent sections.**
Arbitrary Waveform Editor	☞ **See "6 OVERVIEW OF ARBITRARY WAVEFORM CREATION" and subsequent sections.**
Sequence Edit Software	☞ **See "9 SEQUENCE EDITING" and subsequent sections.**

3.3 Exiting the Launcher

The launcher is exited with the Exit icon or the Close button for the lancher.

However, the launcher cannot be exited while the subsoftware is running.

Exit the subsoftware before exiting the launcher.

3.4 Notes

Settings for connected devices must be made on each subsoftware application.

For details, see **“System settings”** or **“Model settings”** for each subsoftware.

Remote Control	☞ **See “4.9 System Setup”.**
Arbitrary Waveform Creation	☞ **See “8.5.1 Model setting”.**
Sequence Editing	☞ **See “11.7 System Settings”.**

⚠ Caution

This mark indicates information for the avoidance of user injury or damage to the equipment during handling.

4. REMOTE CONTROL

4.1 Component Names

When the SPSC RMT remote control (SPSC RMT) is started, the following remote control screen appears.

4.1.1 Remote control screen

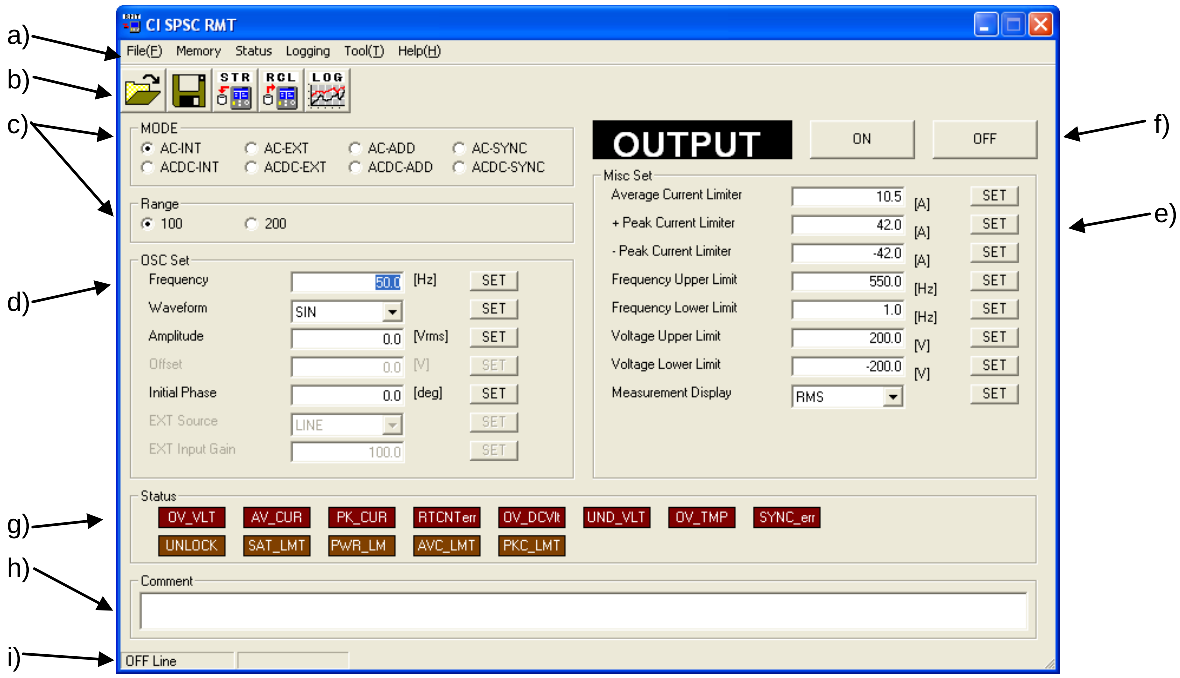


Figure 4-1 Remote Control Screen

a) Menu organization

☞ **See “4.2 Menu Organization”.**

b) Toolbar

☞ **See “4.1.2 Toolbar”.**

c) Mode and range

☞ **See “4.5.1 Mode and Range”.**

d) Oscillator settings

☞ **See “4.5.2 Oscillator settings”.**

e) Misc settings

☞ **See “4.5.3 Miscellaneous settings”.**

f) Output settings

☞ **See “4.5.4 Output setting”.**

g) Status monitoring

☞ **See "4.8 Status Display".**

h) Comment

☞ **See "4.6.3 Comments".**

i) Status bar

☞ **See "4.1.3 Status bar".**

4.1.2 Toolbar

Details for the toolbar on the remote control screen are shown below.

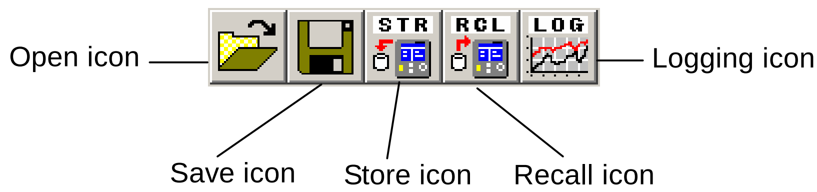


Figure 4-2 Toolbar

4.1.3 Status bar

Details for the status bar on the remote control screen are shown below.

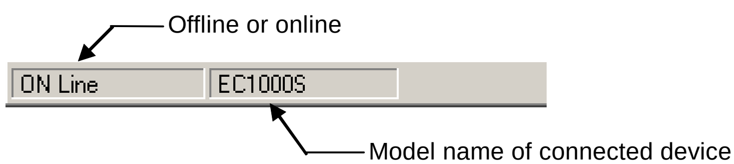


Figure 4-3 Status Bar

Mode indicator

The mode indicator displays "**ON Line**" or "**OFF Line**".

☞ **See "1.4 Online/Offline".**

Connected device name

Displays the connected device name. No data is displayed here in the offline status.

4.2 Menu Organization

The menu organization of **“SPSC RMT Remote Control Software”** is shown below.

File (F)	Open(O)*	Ctrl+O	Opens the device setting file.
	Save(S)	Ctrl+S	Saves data in the current device setting file.
	Save As(A)		Saves data in the new device setting file.
	Exit(X)		Exits this software.
Memory	Store		Displays the "Store Memory" dialog box.
	Recall		Displays the "Recall Memory" dialog box.
	Reset		Initializes the device to the factory settings.
Status	Monitor		Sets the start or termination of status monitor.
	Clear		Clears the status display.
Logging	Logging		Displays the logging screen.
Tool (T)	Set up(S)		Displays the "System Setup" dialog box.
Help (H)	About(A)		Displays the "Version Information" dialog box.

4.3 Start

For how to start the “**SPSC RMT Remote Control Software**”, **see “3.2 Starting the Subsoftware.”**
The following message appears when the software is started for the first time or when the device previously set is not connected.

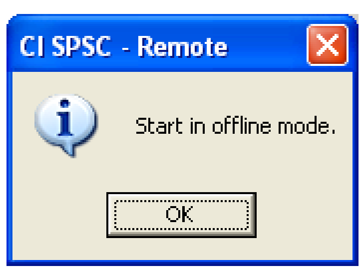


Figure 4-4 Message Displayed at Startup

After starting the software, connect the device and make system settings.

☞ **See “4.9 System Setup”.**

If the above operations are not performed, the device remains in the “**offline**” status.
If a sequence is being executed or held on a device that can be connected at startup, the sequence is stopped and the software is started.
If the device is in the online mode, the connected device is queried and the query results from the device for each setting item on the remote control screen are reflected on the screen.

4.4 Exit

The software is exited when **[File(F)] - [Exit(X)]** is selected or when ☒ (close box) is clicked.

4.5 Operations for Each Unit

This section describes the operations of each unit in the “ON Line” status.
Operations may be partly different in the “OFF Line” status because the device status is not imitated.

☞ **See “4.11 Restrictions in the Offline Mode”.**

Setting certain items may cause an error depending on the device status. For details on errors, refer to **“4.10 Errors”** and **“12 ERROR MESSAGES”**.

4.5.1 Mode and Range

To set the mode or range, check the radio button for the desired mode or range. The setting on the device changes accordingly.

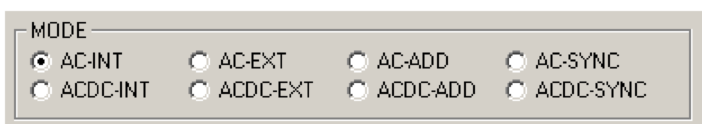


Figure 4-5 Mode Settings

Figure 4-6 Range Settings

Switching the mode or range may take time, depending on the setting device status. The mouse pointer turns into an hourglass during switching.

When the device completes the mode or range switching process, other setting values are queried and the screen is refreshed.

⚠ **Caution**

An error occurs if mode or range switching is attempted when the output is on.

4.5.2 Oscillator settings

Set each output setting item.

Input a numerical value or select an item from the list and click the **[SET]** button. The item is then set to the device.

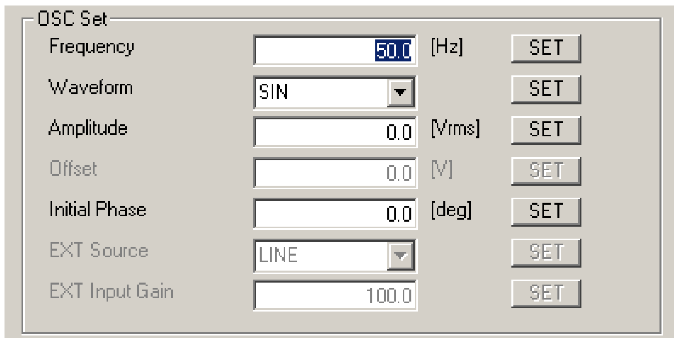


Figure 4-7 Oscillator Settings (AC-INT mode)

For a numerical setting input item, the setting range appears when the mouse pointer is moved to the input area.

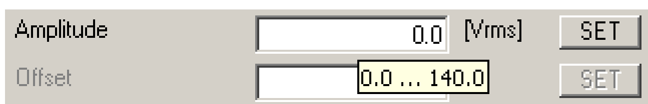


Figure 4-8 Setting Range Display Example

The items that cannot be set in the current mode are disabled and cannot be changed. The setting values for the disabled items do not reflect the settings on the device.

See the device manual for the items that can be set in each mode.

4.5.3 Miscellaneous settings

Make the settings, such as limiter values other than output setting items, or the upper or lower limit of the range.

As with “oscillator settings”, input a numerical value or select an item from the list and click the **[SET]** button. The item is then set to the device.

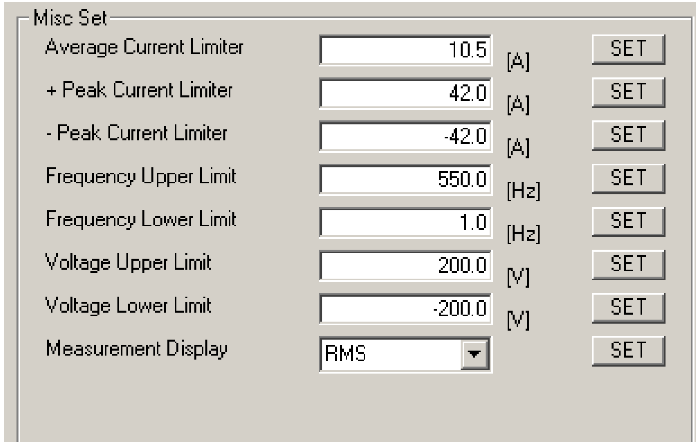


Figure 4-9 Miscellaneous Settings

The limiters or range limit values under the miscellaneous settings can only be set to the device through the "SPSC RMT Remote Control Software". Input checking for items corresponding to the "oscillator settings" is not performed.

Like the "oscillator settings", the setting range for the numerical setting input item is also displayed under the miscellaneous settings.

However, even if the value is within the displayed setting range, it may not be possible to set the value to the items related to the device setting range limit to the device, depending on the device status.

See the device manual for details on the device setting range limit.

4.5.4 Output setting

To set output, click the $\boxed{\text{ON}}$ or $\boxed{\text{OFF}}$ button.

The setting device status is displayed next to the $\boxed{\text{OK}}$ button. "OUTPUT" is displayed in bright yellow at the ON status.

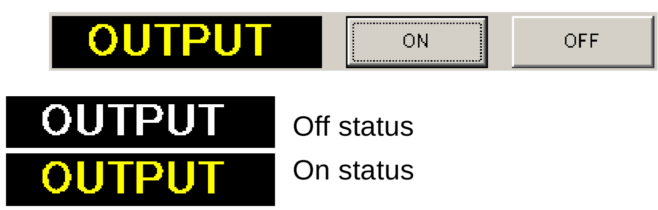


Figure 4-10 Output Setting

⚠ Caution

It may not be possible to turn on output, depending on the device status. In such a case, an error occurs.

The device is queried for the output status about every two seconds and the result is reflected on the screen.

4.6 Device Setting File

The settings for each setting item that can be set with the "**SPSC RMT Remote Control Software**" (except for output on/off setting) can be saved to and read from the "device setting file".
The extension for the "device setting file" is ".MSF".
If the device is in the online status when the device setting file is read, the items are set to the device according to the device setting file to be read.

4.6.1 Saving the device setting file

Select **[File(F)] - [Save As(A)]** or click the Save button to display the **[Save As]** dialog box. Specify a file name and click the OK button. Settings are saved under the specified file name.
When the save operation is completed, the saved file name is displayed on the title bar on the remote control screen.

If **[File(F)] - [Save(S)]** is selected when the device setting file has been already saved or read, the existing device setting file is overwritten.
If the above operation is attempted when any device setting file has not yet been saved or read, the operation will be the same as the **[Save As(A)]** operation.

4.6.2 Reading the device setting file

Select **[File(F)] - [Open(O)]** or click the Open button to display the **[Open File]** dialog box. Specify a file name and click the OK button. The setting values are then read from the specified device setting file.

If the device is in the online status when settings are read, the read items are set to the device according to the device setting file currently read. If the output is in the on status, the output is turned off, each setting item is set to the device, and then the output is turned on again.

If the read operation is completed, the read file name is displayed on the title bar on the remote control screen.

4.6.3 Comments

The comment input in the comment field is saved to the "device setting file", in addition to the settings.
When the device setting file is read, the comment information in the read file is displayed in the comment field.
Up to 128 characters can be input to the comment field and saved to the device setting file.

4.7 Memory

4.7.1 Store and recall

Store or recall the device in the online status.

See the device manual for setting items saved during the storing or recalling operation.

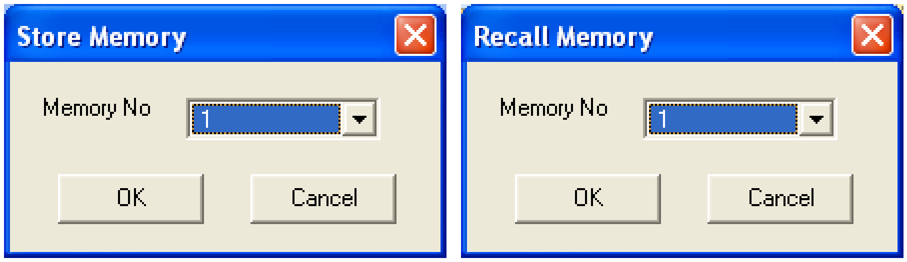


Figure 4-11 Store/Recall Memory Dialog Box

a) Store

Select **[Memory] - [Store]** or click the Store button to display the **[Store Memory]** dialog box.

Set the memory number to be stored in **[Memory No]** in the **[Store Memory]** dialog box and click the OK button. Data is then stored in the device.

b) Recall

Select **[Memory] - [Recall]** or click the Recall button to display the **[Recall Memory]** dialog box.

Set the memory number to be recalled in **[Memory No]** in the **[Recall Memory]** dialog box and click the OK button. Data is then recalled in the device.

After the recall operation is completed on the device, the device is queried and the query results from the device are set to each setting item on the remote control screen.

⚠ Caution

An error occurs if the recall operation is attempted when the output is turned on.

4.7.2 Reset

The device is reset when **[Memory] - [Reset]** is selected.

When the device is reset, the device returns to the factory settings.

⚠ Caution

An error occurs if the reset operation is attempted when the output is turned on.

See the device manual for the factory settings of the device.

4.8 Status Display

4.8.1 Status monitor

The status monitor queries the device for status information about every two seconds and refreshes the status display. The statuses to be monitored are listed below.

Table 4-1 Status Display List

Item	Indication on Remote Control Screen	Display Color for on Status
Peak current limiter operation	PKC_LMT	Orange
Average current limiter operation	AVC_LMT	Orange
Power limiter operation	PWR_LMT	Orange
Operation quantity saturation limiter operation	SAT_LMT	Orange
External synchronization signal UNLOCK	UNLOCK	Orange
External synchronizing frequency range protection	SYNC_err	Red
Overheat protection	OV_TMP	Red
DC undervoltage protection	UND_VLT	Red
DC overvoltage protection	OV_DCVlt	Red
Output peak current protection	PK_CUR	Red
Realtime control protection	RTCNTerr	Red
Output average current protection	OV_CUR	Red
Output overvoltage protection	PK_VLT	Red

Every time **[Status] - [Monitor]** is selected, the monitor is toggled between the active and inactive status. When the monitor is in the active status, the **[✓Monitor]** is displayed.

When the query result indicates that the device is in the relevant status (on status), the display glows (bright display). The display examples for the off status (left) and on status (right) are shown below.

Figure 4-12 Status Display Example (UNLOCK)

4.8.2 Clearing the status

When **[Status] - [Clear]** is selected, the status display is cleared (turned-off status) and the warning cause is cleared from the device.

However, even after the warning causes are cleared from the device, some warning causes may remain, depending on the device status.

The warning cause can be cleared by the status clear operation even if the device is in the "warning display" status.

The red status display indicates the status where the device itself is in the warning display status.

If you try to change the "oscillator or miscellaneous settings" without clearing these status items, an error occurs.

4.9 System Setup

When **[Tool(T)] - [System Setup(S)]** is selected, the **[System Setup]** dialog box appears.

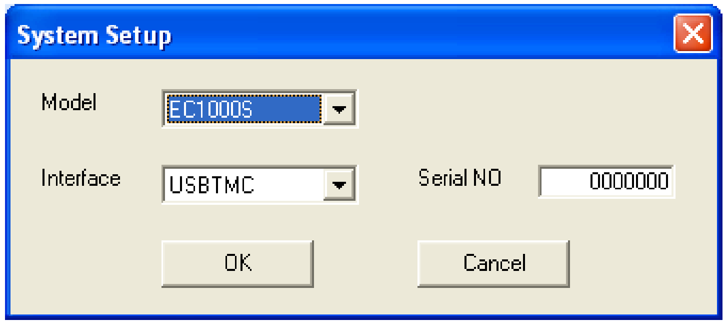


Figure 4-13 System Setup Dialog Box

Model	Select the model name of the device to be connected. (Only EC1000S can be selected.)
Interface	Select the external interface of the device to be connected. (Only USBTMC can be selected.)
Serial NO	Input the serial number of the device to be connected. Set a 7-digit number in the EC1000S. If this number is not correct, the system cannot communicate with the device.

When **[Model]**, **[Interface]** and **[Serial NO]** are set and the OK button is clicked, the software communicates with the device according to the set conditions. If the communication is established with the device under the set conditions, the device enters into the online status.
If the communication fails, the following message appears.

Figure 4-14 System Setting Confirmation

If the OK button is clicked, the message and system setup dialog box are closed and the device enters into the offline status. If the Cancel button is clicked, the system setup dialog box reappears.

4.10 Errors

"SPSC RMT" checks for device errors when the device has been set in the online status.
If an error occurs on the device, an error message appears.

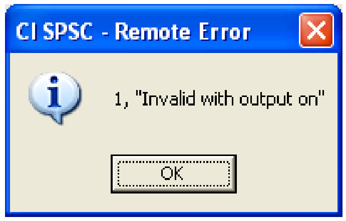


Figure 4-15 Error Message Example

The error message displays the error number and details for the corresponding error. For details, see the device manual.

If an error occurs after a certain item is set to the device, the device is queried for the setting item value and the result is reflected on the remote control screen.

4.11 Restrictions in the Offline Mode

It the mode or range is switched in "SPSC RMT" in the online status, all parameters are queried after completion of switching operation and the results are reflected on the remote control screen.
The following restrictions apply in the offline status because the device status is not imitated.

a) Mode switching

After the mode switching operation, each setting item displays the setting value or details that were set immediately before the operation.

b) Range switching

The value of the item for which setting range varies depending on the range after range switching operation is rounded to the allowable maximum value.

c) Creation of device setting file

To create the device setting file in the offline status, be sure to set each setting item before clicking the corresponding SET button.

5. LOGGING

5.1 Component Names

The logging screen for the “**SPSC RMT Remote Control Software**” is shown below.

5.1.1 Logging screen

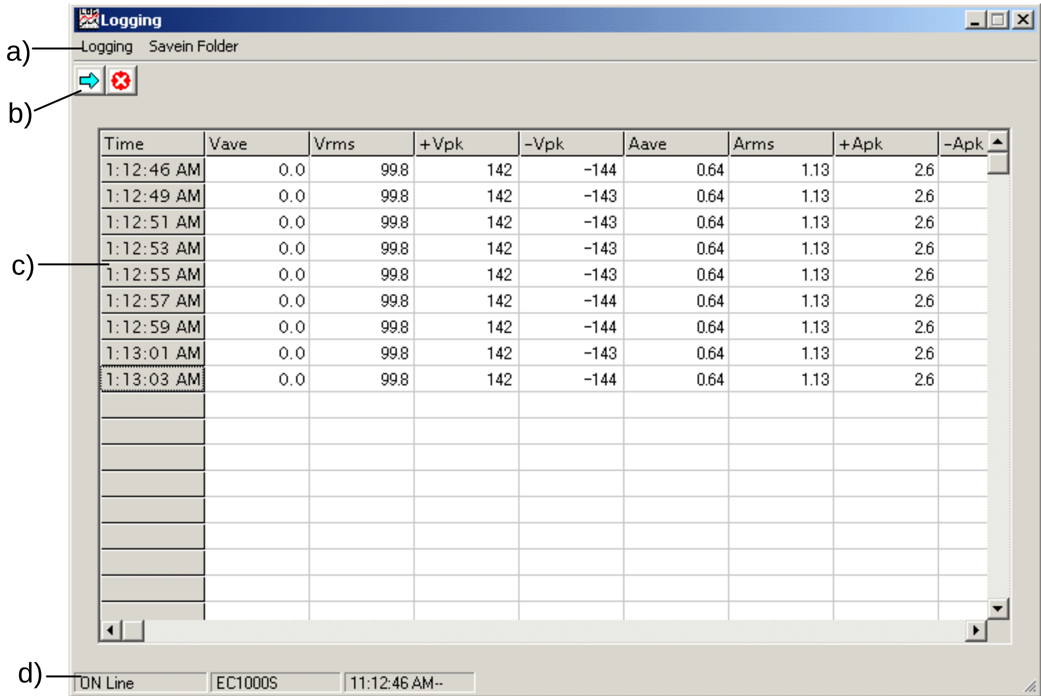


Figure 5-1 Logging Screen

a) Menu organization

☞ **See “5.2 Menu Organization”.**

b) Toolbar

☞ **See “5.1.2 Toolbar”.**

c) Data display area

☞ **See “5.5 Data Display Area”.**

d) Status bar

☞ **See “5.1.3 Status bar”.**

5.1.2 Toolbar

The toolbar on the logging screen is detailed below.

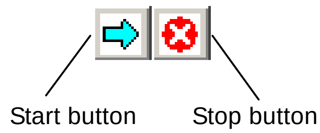


Figure 5-2 Toolbar on Logging Screen

5.1.3 Status bar

The status bar on the logging screen is detailed below.

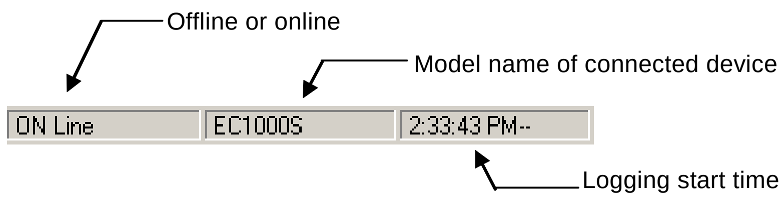


Figure 5-3 Status Bar on Logging Screen

Mode indicator

The mode indicator displays “ON Line” or “OFF Line”.

☞ **See “1.4 Online/Offline”.**

Connected device name

Displays the connected device name. No data is displayed here in the offline status.

Logging start time

Displays the time when logging was started. No data is displayed here in the offline status.

5.2 Menu Organization

Menu	Item	Description
Logging	Start(S)	Starts logging.
	Stop(E)	Stops logging.
	Clear	Clears data in the data display area.
Setting(S)	Logging Condition	Displays the "Logging Conditions" dialog box.

5.3 Start and Termination

To display the logging screen, select **[Logging] - [Logging]** or click the Logging button on the remote control screen.

☞ **See “4.2 Menu Organization”.**
☞ **See “4.1.2 Toolbar”.**

Clicking the Close button on the logging screen closes the logging screen regardless of the logging status.
Exiting the remote control screen also closes the logging screen regardless of the logging status.

5.4 Starting and Stopping Logging

To start logging, select **[Logging] - [Start]** or click the Start button.
When logging is started, the logging start time information is displayed on the status bar.

☞ **See “5.1.3 Status bar”.**

To stop logging, select **[Logging] - [Stop]** or click the Stop button.
When logging is stopped, the logging start time information is cleared from the status bar.

5.5 Data Display Area

The data display area on the logging screen displays up to 3,600 logging data lines. Use the scroll bars to display rows and columns that cannot be displayed within the logging screen.

The leftmost column displays the logging time.
The first row displays measurement items, and the second and subsequent rows display logging data.
Measurement items differ depending on the device mode and the measurement display items.
If logging data has exceeded 3,600 rows when you log new data, the logging data on the first row is deleted and the new data is displayed on the first row.

When **[Logging] - [Clear]** is selected, logging data is cleared from the data display area. If logging is being performed, new logging data is displayed on the second and subsequent rows after the clear operation.
If logging data has been saved to a file, the clear operation does not clear the data that has been logged so far.

5.6 Logging Conditions

Select **[Setting(S)] - [Logging Condition]** to display the **[Logging Condition]** dialog box.

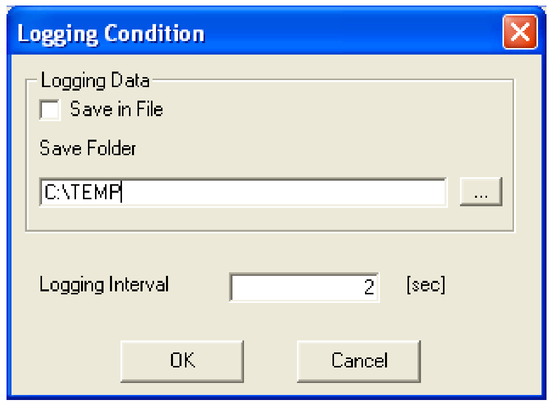


Figure 5-4 Logging Condition Dialog Box

Save in File	When this check box is selected, currently logged data is saved to a file.
Save Folder	Specify the folder to which logging data is saved. To specify the destination folder, click the button to display the **[Specify Folder]** dialog box where the destination folder can be specified.
Logging Interval	Specify the logging interval between 1 and 60 seconds.

When the OK button is clicked, setting conditions are checked. If no error is detected, the setting conditions are saved and the dialog box is closed. Saved conditions are used for logging next time the software is started. Clicking the Cancel button closes the dialog box without saving setting conditions.

Setting conditions cannot be changed during logging.

⚠ **Caution**

The logging interval does not guarantee logging operation at the specified intervals.

5.7 Logging Data File

The logging data file saved while logging is saved under the following conditions:

File name The file is named as YYYYMMDD_HH_MM_SS.txt using the logging start time information (extension: txt)

File format

First row	Measurement item (separated with commas)
Second and subsequent rows	Time information, logging data, ... (separated with commas). For logging data, see the next section.

5.8 Logging Data

The following measurement values are logged depending on the device mode and measurement value display.

Table 5-1 Logging Item

Mode setting value		AC-INT AC-EXT AC-ADD	AC-SYNC	ACDC-INT ACDC-EXT ACDC-ADD	ACDC-SYNC	AC-INT
Measurement value display setting value		RMS AVG PEAK	RMS AVG PEAK	RMS AVG PEAK	RMS AVG PEAK	HC1 : HC40
Measurement item	Unit					
Average voltage value	[V]	○	○	○	○	×
Effective voltage value	[Vrms]	○	○	○	○	×
+ voltage peak value	[Vpk]	○	○	○	○	×
– voltage peak value	[Vpk]	○	○	○	○	×
Average current value	[A]	○	○	○	○	×
Effective current value	[Arms]	○	○	○	○	×
Peak positive current value	[Apk]	○	○	○	○	×
Peak negative current value	[Apk]	○	○	○	○	×
Peak current hold	[Apk]	○	○	○	○	×
Effective power	[W]	○	○	○	○	×
Apparent power	[VA]	○	○	○	○	×
Reactive power	[var]	○	○	○	○	×
External synchronous frequency	[Hz]	×	○	×	○	×
Load power factor	N/A	○	○	○	○	×
Load crest factor	N/A	○	○	○	○	×
Harmonic current	[Arms]	×	×	×	×	○
Harmonic current	[%]	×	×	×	×	○

⚠ Caution

At total of 80 items, that is, 1st to 40th effective current values and the rates of each current value to the 1st current assuming the 1st current as 100% are logged for the harmonic current.

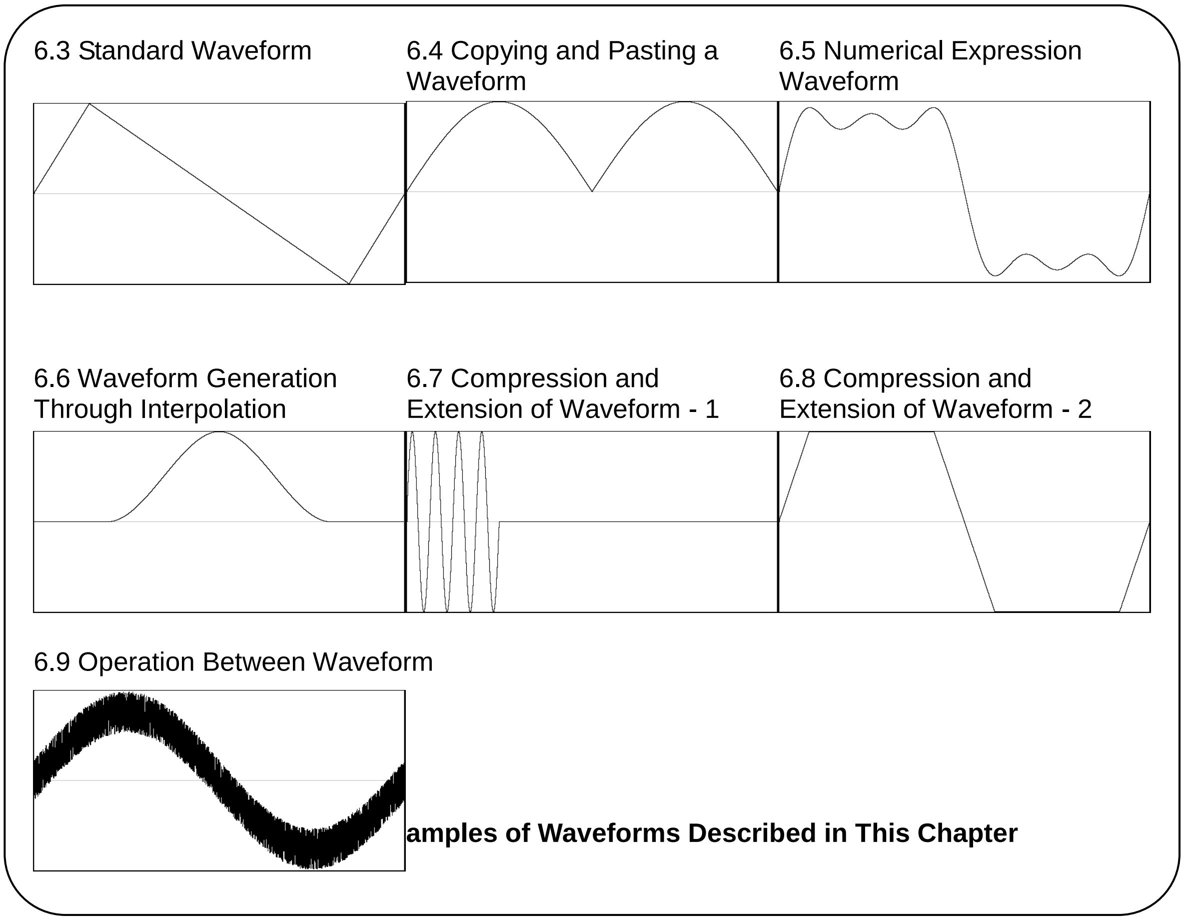
If the mode or the measurement value display setting is changed during logging, the logging screen is cleared once.

6. OVERVIEW OF ARBITRARY WAVEFORM CREATION

6.1 General

This chapter describes several examples so that you can understand basic operations and functions for the "SPSC ARB Arbitrary Waveform Editor" (SPSC ARB).
It will be easier to understand the description if you read it while actually operating the software.

The following conventions are used in this chapter.



amples of Waveforms Described in This Chapter

6.2 Start and Termination

To start the "**SPSC ARB Arbitrary Waveform Editor**", **see "3.2 Starting the Subsoftware"**.
To exit the editor, click ☒ (close box) at the top right or execute **[File] - [Exit]**. The **[Exit Program. Are you sure?]** confirmation message appears in either case. Click the Yes(Y) button.

In the following examples, operations are explained from the default status when the SPSC ARB Arbitrary Waveform Editor is started.
Before performing the operations in each example, exit the SPSC ARB Arbitrary Waveform Editor once and then restart it.

6.3 Standard Waveform

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

Step 1: Click f_x at the top left of the screen. The same result can be obtained when **[Tools] - [Wave Create]** is selected.
The screen titled **[SPSC ARB - Wave Create]** appears.

Step 2: Click the ▼ button to the right of **[Function]** and click **[Triangle]** from the list.
Step 3: Change the numerical value from **[50]** to **[30]** in the number input section to the right of **[Symmetry]** and press the Enter key. This specifies a triangle wave with 30% symmetry.
Step 4: Clicking All Page OK closes the waveform generation screen and returns to the screen where the waveform is displayed.

Explanation 1: In this example, the waveform is generated across the memory size.
In the "SPSC ARB", the waveform can be divided into multiple pages. For example, the fist quarter of a waveform can be allocated to the first page and the latter half of the waveform can be allocated to the second page, and so on.
☞ **See "8.1.1 Range setting and page"**.
To execute the specified waveform across multiple active pages in a batch, click the All Pages OK button.
To execute the displayed page only, click the Page OK button.
In this example, clicking either of the buttons leads to the same result because the first page alone is specified.

Explanation 2: In addition to the triangle wave, the sine wave, square wave (duty ratio variable), and waveform definitions (waveform functions) with the noise, DC, or numerical expression can be selected.
Waveform function example: ☞ **See "6.5 Numerical Expression Waveform".**

6.4 Copying and Pasting a Waveform

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

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

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

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

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

Step 5: Click ○ (option button) to the left of **[○ Interlock (R)]**, making it ◉ (selected status) to set the interlock mode to the marker.
Set **[2048]** in the number area to the right of **[MrkA(X)]** and press the Enter key.

Step 6: Press the V key while holding down the Ctrl key. The same result can be obtained when **[Edit] - [Paste]** is selected.
The waveform data on the clipboard is pasted to the latter half of waveform.

Explanation 1: If the signal generator model is changed and the memory size is no longer 4 KW, 2048 in steps 3 and 5 must be changed to the half of each memory size.

Explanation 2: The operation of pressing the C key while holding down the Ctrl key is hereinafter expressed as Ctrl+C.
Ctrl+C (Copy) leaves the waveform in the copied area as is.
Ctrl+X (Cut) is the same in that the data in the selected area is saved onto the clipboard. The waveform in the selected area is deleted, however.
Ctrl+D (Delete) deletes the waveform in the selected area but the data on the clipboard does not change.

Explanation 3: Use markers A and B to select the range.
For example, when the range specified with the markers is from 0 to 2048, the actual selection range will be 0 ≤ X < 2048.

Explanation 4: For the clipboard, **see ☞ "7.7.2 Clipboard" and your Windows OS manual**.

6.5 Numerical Expression Waveform

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

Step 1: Select **[Setup] - [Setup]**.
The screen titled **[SPSC ARB - System Settings]** appears.

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

Step 3: Click the ▼ button to the right of **[X-Axis Unit]** and click **[User Unit]** from the displayed list. Leave the minimum value to the maximum value two lines below as their initial values, **[0.000000 - 1.000000]**.

Step 4: Click the ▼ button to the right of **[Y-Axis Unit]** and click **[User Unit]** from the displayed list. Leave the minimum value to the maximum value in the last line as their initial values, **[-1.000 - 1.000]**.

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

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

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

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

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

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

Explanation 1: In this example, the horizontal line (X) is treated as 0 to 1 by using the user unit.
Likewise, the vertical line (Y) is treated as ±1 as a whole.
The expression of one cycle of the sine wave is made easier by defining s=2π as a constant so that **[x*s]** is expressed in a formula.

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

6.6 Waveform Generation Through Interpolation

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

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

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

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

Step 4: Click the button at the top left of the screen. The same result can be obtained when **[Tool(T)] - [Interpolate]** is selected.
The screen titled **[SPSC ARB - Interpolate]** appears.

Step 5: Set **[0.5]** in the number area to the right of **[X=]** and input **[1]** in the number area to the right of **[Y=]**, and then click the Add button.

Step 6: Click the Cont Spline button.
The interpolated waveform is displayed on the waveform display screen.
If the waveform is hidden behind the interpolation editing screen and difficult to see, move the screen.

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

Explanation 1: The point set at step 3 is called "control point" in interpolation editing.

Explanation 2: In the case of linear interpolation, the waveform is created by interpolating spaces between control points with straight line.
In the case of a spline, spaces between control points are smoothly interpolated with spline curve.

Explanation 3: In the case of a continuous spline, the selected range is interpolated so that it is smoothly connected to the previous and subsequent ranges as well.
When all ranges are selected, the waveform is interpolated so that the head and tail of the

waveform can be smoothly connected if the waveform is repeated.

6.7 Compression and Extension of Waveform - 1

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

Step 1: Click the button at the top left of the screen.
A sine wave is selected in the initial status.
Change the numerical value to the right of **[Period]** from **[1]** to **[4]** to make a sine wave with four cycles.
Click the All Page OK button to return to the waveform display screen.

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

Step 3: When the memory size is 8 KW, **[8192.000Word]** is displayed to the right bottom of the waveform display screen.
Leave the number area to the right of **[Start X=]** as **[0]**.
Set the quarter of memory size, **[2048]** in the number area to the right of **[End X=]** and press the Enter key.
The four sine waves displayed across the waveform are contracted to the first quarter on the waveform display screen.
If the waveform is hidden behind the contraction/extraction screen and difficult to see, move the screen.

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

Explanation 1: **[Start Point(S) X=]** is left as **[0]** in this example, so the original waveform is contracted to the first quarter of waveform on the waveform display screen.
For example, when **[Start Point(S) X=]** is set to **[2048]** and **[End Point(E) X=]** is set to **[4096]**, the original waveform is contracted to the second quarter on the waveform display screen.

Explanation 2: It is also possible to specify the whole waveform.
Select a part of waveform on the waveform display screen with markers A and B in advance.
If the Fit Length button is then clicked on the contraction/extraction screen, the selected range is extended to the whole waveform.

6.8 Compression and Extension of Waveform - 2

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

Step 1: Click the button at the top left of the screen.
A sine wave is selected in the initial status.
Click the button to the right of **[Function]**, click **[Triangle]** from the displayed list.
Click the All Page OK button to return to the waveform display screen.

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

Step 3: Change the setting in the number area to the right of **[Max.(X)]** from **[32767]** to **[100000]** and press the Enter key.
Change the setting in the number area to the right of **[Min.(N)]** from **[-32767]** to **[-100000]** and press the Enter key.
The triangle wave is vertically extended, clipped and changed to a trapezoidal wave on the waveform display screen.
If the waveform is hidden behind the contracting/extension screen and difficult to see, move the screen.

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

Explanation 1: It is also possible to vertically contract or move the waveform by specifying the maximum and minimum numerical values at step 4.
If the positive and negative full scales are exceeded as a result of extension or move, the waveform is clipped to the positive and negative full scales.

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

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

Explanation 4: The vertically reversed waveform can be obtained by setting **[-100000]** as the maximum value and **[100000]** as the maximum value at step 3.

Explanation 5: Though the contraction/extraction ratio is specified with **[Max/Min]** in this example, **[Amp/Off]** can also be used to specify this ratio.
Click ○ (option button) to the left of **[○ Amp/Off(O)]** making it ◉ (selected status). The result same as in this example can be obtained by setting **[Amplitude]** to **[200000]** and **[DC Offset]** to **[0]**.

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

6.9 Operation Between Waveforms

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

Step 1: Click the button at the left top of the screen.
A sine wave is selected in the initial status.
Change the numerical value to the right of **[Function]** from **[65534]** to **[50000]** to reduce the amplitude a little bit.
Click the All Page OK button to return to the waveform display screen.

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

Step 3: Click the Created Waveform button in the middle of the inter-waveform operation screen.
The screen titled **[SPSC ARB – Waveform Create]** appears as when the button is clicked.

Step 4: Click the button to the right of **[Function]** and click **[Noise]** from the displayed list.
Change the numerical value to the right of **[Amplitude]** from **[65534]** to **[15000]**.
Click the Page OK button to return to the inter-waveform operation screen.

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

Step 6: Click the OK button to return to the waveform display screen.
The waveform superposing noise over the sine wave is now created.

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

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

Explanation 3: In this example, the waveform created on the waveform generation screen is used for operation.
The data on the “clipboard” can be used by clicking the Clip Board button in step 3.
Clipboard: ☞ **See “6.4 Copying and Pasting a Waveform”.**

Explanation 4: It is convenient to set the vertical axis to ±1 of the user unit as in the example in “**6.5 Numerical Expression Waveform**” when executing multiplication.
Under this setting, the result of multiplying full scale values will be also a full scale value.

7. ARBITRARY WAVEFORM – OPERATIONS ON WAVEFORM DISPLAY SCREEN

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

How to start: ☞ **See “3.2 Starting the Subsoftware”.**

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

7.1 Organization and Functions of Waveform Display Screen

“Figure 7-1 Waveform Display Screen” shows the names of each component on the waveform display screen.

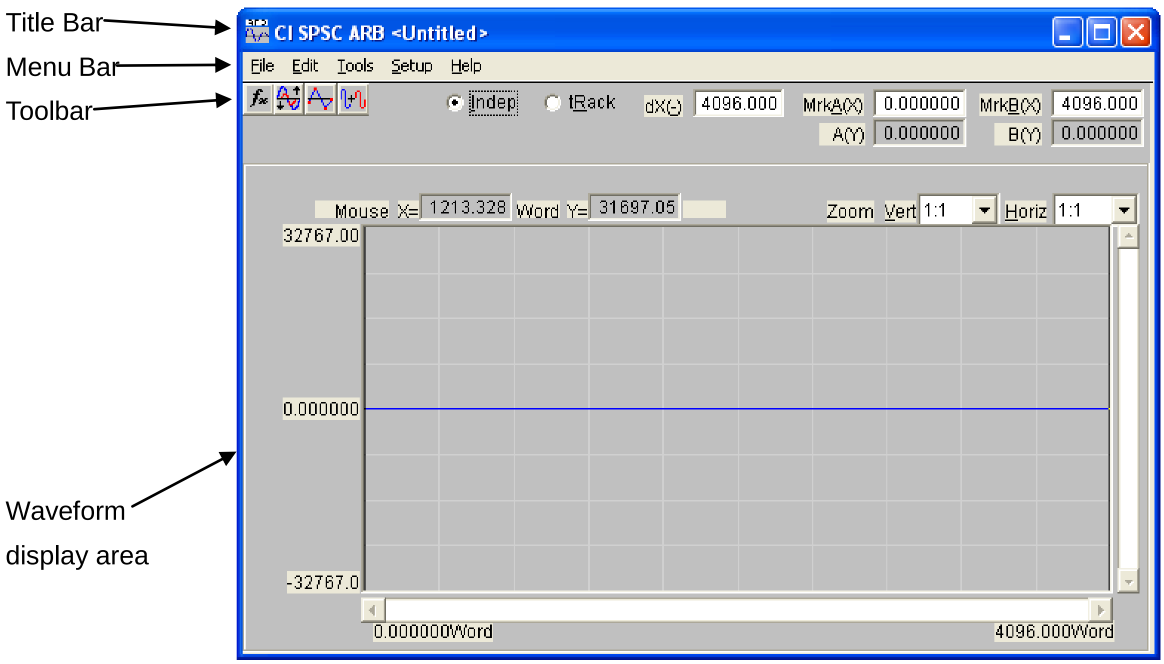


Figure 7-1 Waveform Display Screen

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

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

The menu bar has a pull-down menu.
Clicking a menu name displays the menu options. Clicking an option executes that function.
Otherwise, pressing the Alt key and pressing the key for the underlined alphabetic character to the right of the menu name displays the options for the menu (for example, Alt, F displays the options for the **[File]** menu).
Clicking the key for the underlined alphabetic character to the right of the option executes that function.
If **[Ctrl + *]** (*: an alphabetic character) is displayed to the right of the menu option, the corresponding function can be directly executed when the menu option is not displayed. (For example, **[Ctrl + V]** is displayed to the right of **[Paste]** on the **[Edit]** menu. In this case, pressing Ctrl + V is the same operation as selecting **[Edit] - [Paste]**.)

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

: Waveform create screen	☞ **See"8.1 Generation of Standard Waveform and Numerical Expression Waveform".**
: Compress/Decompress screen	☞ **See"8.2 Contraction/Extension".**
: Interpolate screen	☞ **See"8.3 Waveform Generation Through Interpolation".**
: Operate screen	☞ **See"8.4 Operation Between Waveform".**

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

The waveform display area contains the waveform display, display magnification (zoom) ratio selection, and the mouse pointer position display.
If an underlined alphabetic character is displayed to the right of the item name on the toolbar or in the waveform display area, pressing the underlined alphabetic character while holding down the Alt key selects the corresponding item.
For example, Alt + H (pressing the H key while holding down the Alt key) selects **[Horiz Zoom]**. Note that Alt, H (pressing the Alt key and then pressing the H key) displays the **[Help]** menu options on the menu bar.
Clicking the input/display area to the right of the item name also selects that item.

Example: MrkA (X) 0.000000

Click here or press Alt + A.

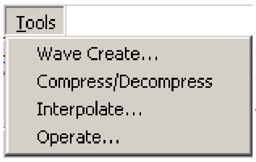
Clicking ○ (option button) to the left of the item name selects the function and the option button turns to ◉ (selected status).

Example: ○ tRack

Click here or press Alt + R.

7.2 Tool Menu

The tool menu options are shown below.



Opens the waveform create screen, as does the button on the toolbar.
Opens the compress/decompress screen, as does the button on the toolbar.
Opens the interpolate screen, as does the button on the toolbar.
Opens the operate screen, as does the button on the toolbar.

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

Waveform create screen	☞ **See "8.1 Generation of Standard Waveform and Numerical Expression Waveform".**
Compress/decompress screen	☞ **See "8.2 Contraction/Extension".**
Interpolate screen	☞ **See "8.3 Waveform Generation Through Interpolation".**
Operate screen	☞ **See "8.4 Operation Between Waveform".**

7.3 Setting Menu

The setting menu options are shown below.

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

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

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

☞ **See "8.5 Transferring the Waveform and Settings".**

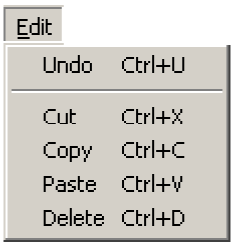
Each time **[Setup] - [Show Grid]** (Alt, S, G) is selected, the grid displayed in the waveform display area is turned on or off.

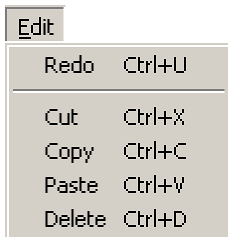
No grid is printed out when a waveform is printed out. ☞ **See "7.6.6 Print".**

7.4 Undo and Redo

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

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





7.5 Zooming and Scrolling the Display

7.5.1 Vertical zoom

The waveform display can be independently zoomed vertically or horizontally.

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

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

To increase the magnification ratio, press Alt+V, select **[Zoom Vert]**, and press the ↓ or → key. To decrease the magnification ratio, press the ↑ or ← key. The Home key cancels zooming and the End key zooms the waveform to maximum.

7.5.2 Horizontal zoom

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

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

To increase the magnification ratio, press Alt+H, select **[Horiz]** and press the ↓ or → key. To decrease the magnification ratio, press the ↑ or ← key. The Home key cancels zooming and the End key zooms the waveform to maximum.

7.5.3 Scrolling

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

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

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

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

7.5.4 Marker and range selection

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

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

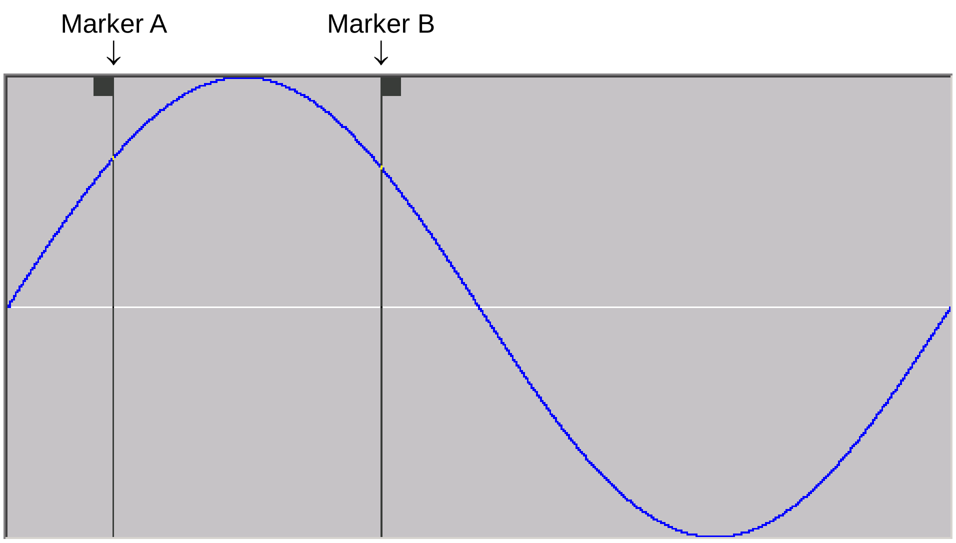
The markers in the SPSC ARB are displayed as vertical lines in the waveform display area.

7.5.5 Marker operations

a) Marker types

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

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



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

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

b) Moving the marker (mouse dragging)

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

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

When the marker is moved by mouse dragging, the waveform data address is used as the moving unit. When one dot on the display corresponds to multiple addresses due to the display magnification ratio, the address corresponding to one dot on the display is used as the moving step.

c) Marker moving (numerical value setting)

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

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

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

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

d) Marker interlock mode

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

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

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

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

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

7.5.6 Range selection

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

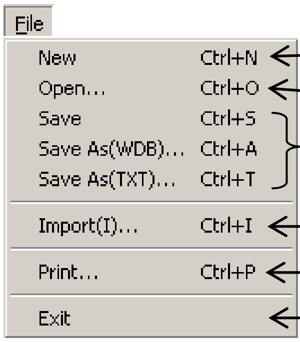
- Copy/cut/paste range of waveform ☞ **See "7.7 Copy and Paste".**
- Contraction/extension range ☞ **See "8.2 Contraction/Extension".**
- Range to generate the waveform through interpolation ☞ **See "8.3 Waveform Generation Through Interpolation".**
- Inter-waveform operation range ☞ **See "8.4 Operation Between Waveform".**

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

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

7.6 File Operations and Printing

The file menu options are shown below.



Starts multiple SPSC ARBs. ☞ **See "7.6.2 New".**

Reads waveform data file.

Saves waveform data file. ☞ **See "7.6.3 Specialized format file".**

Reads data file. ☞ **See "7.6.4 Text file".**

Prints displayed waveform. ☞ **See "7.6.5 Import".**

Exits the SPSC ARB. ☞ **See "7.6.6 Print".**

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

7.6.1 File types

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

- Specialized format file containing waveform data, signal generator settings, and display unit settings (.wdb)

  ☞ **See "7.6.3 Specialized format file".**
- Text file containing waveform data only (.txt) ☞ **See "7.6.4 Text file".**
- Specialized format text file containing standard waveform types as well as parameters, numerical expression waveform's constants and expressions (.wfn)

  ☞ **See "8.1.5 File operation".**
- Text file containing control points only (.prn, .tsv, .csv)

  ☞ **See "8.3.3 File operation".**
- "SPSC ARB" specialized format file containing signal generator settings, display unit settings and other data (.ocb) ☞ **See "8.5.7 File operation".**

7.6.2 New

Selecting **[File] - [New]** (Alt, F, N or Ctrl+N) starts another "SPSC ARB". That "SPSC ARB" is started at the position where the first SPSC ARB was started.

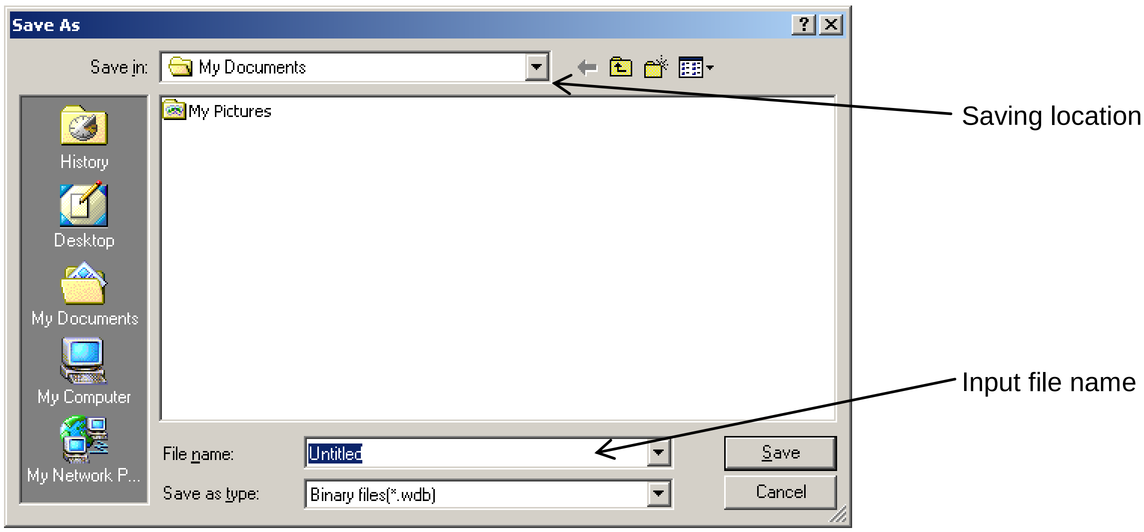
It is possible to exchange data between "SPSC ARBs" via the clipboard.

☞ **See "7.7.2 Clipboard" and "8.4.2 Object of operation".**

7.6.3 Specialized format file

Almost all necessary information such as waveform data created using the SPSC ARB, signal generator's settings, and display unit setting can be saved to a file in batch.

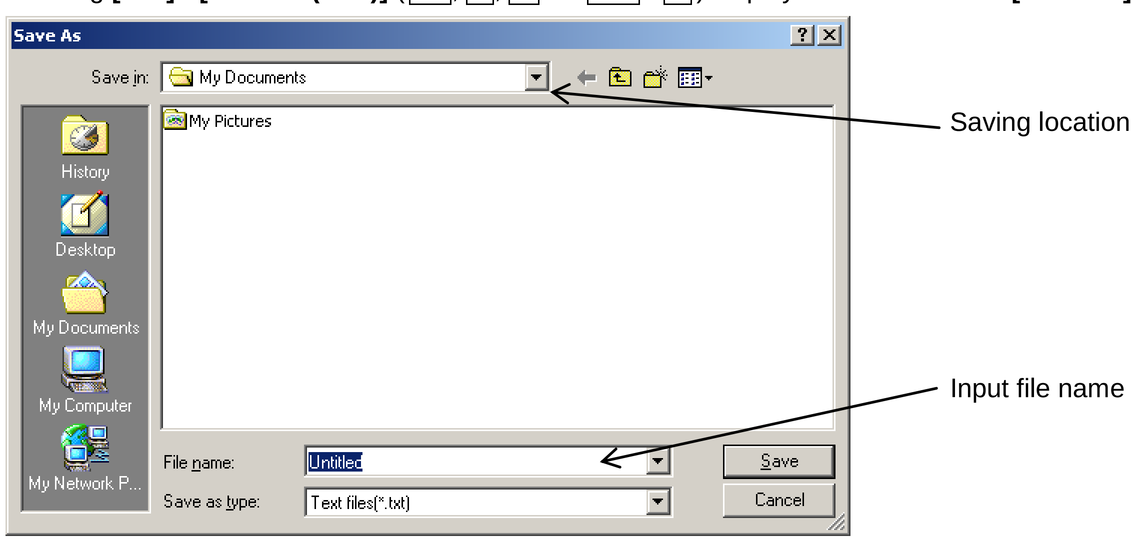
Selecting **[File] - [Save As(WDB)]** (Alt, F, A or Ctrl+A) displays the screen titled **[Save As]**.
Select a saving location, input a file name, and click the Save button. The file extension is ".wdb" and can be omitted during file name input.



7.6.4 Text file

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

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



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

In the text file, 16-bit (0 to +65535) data is saved as a numeric string. One row contains one numerical string data unit. The number of rows is the same as the memory size set on the system setting screen.

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

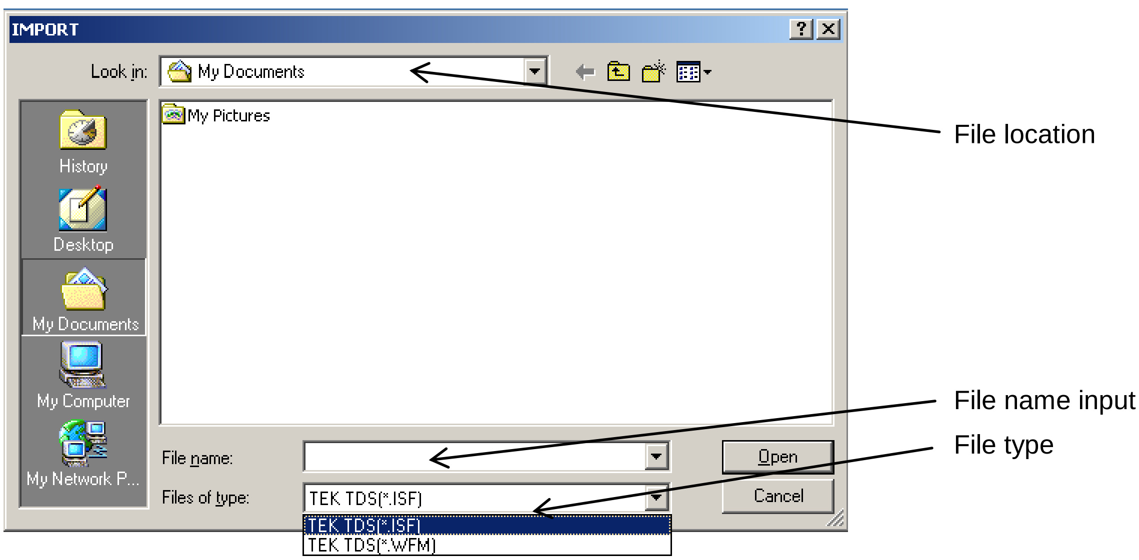
Otherwise, the SPSC ARB can read the text file created using the text editor, spreadsheet software, or other application. When creating a text file, put one data unit, which must be a 16-bit signed integer (–32768 to +32767), on one row.

The number of data units in a data file should be 65536 or smaller. If the number of data units in a data file is larger than the system setting, **[Memory Size]** in this range, excess data is skipped.
If the number of data units is smaller than the system setting, they are read into the beginning of the waveform and the rest remains the same.

7.6.5 Import

Waveform data created using other software than the "SPSC ARB" can be imported as SPSC ARB's waveform data.

Selecting **[File] - [Import(I)]** (Alt, F, I or Ctrl+I) displays the screen titled **[IMPORT]**.



Select a file type in **[Files of type]**. Specify a file location, input a file name, and click the Open button.
If data has already been read from a file in the specialized format or text format, <Untitled> is displayed on the title of the waveform display screen.

If the number of data units in the data file specified at import is larger than the system setting, **[Memory Size]**, the data is compressed. Data is imported so that the original data system should be the waveform data memory size.
If the number of data units is smaller than the system setting, they are read into the beginning of the waveform and the rest remains the same.

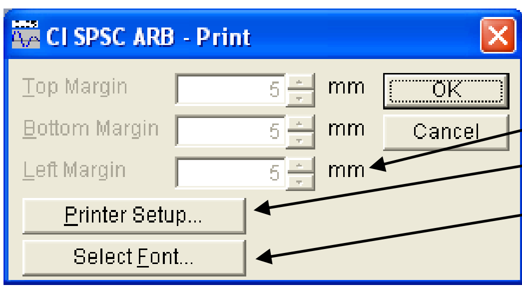
⚠ Caution

The import function cannot be used to save data in the same file format as the file imported.

7.6.6 Print

Waveform data created using the “SPSC ARB” can also be printed out as a waveform. However, note that the grid is not printed out. ☞ **See “7.3 Setting Menu”.**

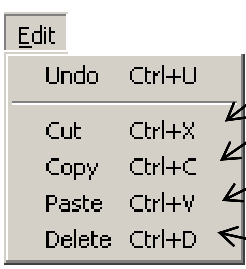
Selecting **[File] - [Print]** (Alt, F, P or Ctrl + P) displays the screen titled **[SPSC ARB - Print]**.
Make settings for the printer or font as needed and click the OK button.
The upper, lower, and left margins cannot be set when printing the waveform.



Margin setting is invalid when printing the waveform.
Printer settings
Font specification

7.7 Copy and Paste

In the “SPSC ARB”, waveform data can be edited using the cut, copy, and paste functions.



Cuts the waveform data in the selected range to the clipboard.
Copies the waveform data in the selected range to the clipboard.
Replaces the waveform data in the selected range with the data on the clipboard.
Deletes the waveform data in the selected range.

7.7.1 Edit operation

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

For details on each editing operation, see “**Figure 7-2 Waveform Editing Operation**”.

7.7.2 Clipboard

Executing the cut or copy operation sends the waveform data in the selected range to the clipboard.

The clipboard is a temporary data storage area provided in Windows.

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

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

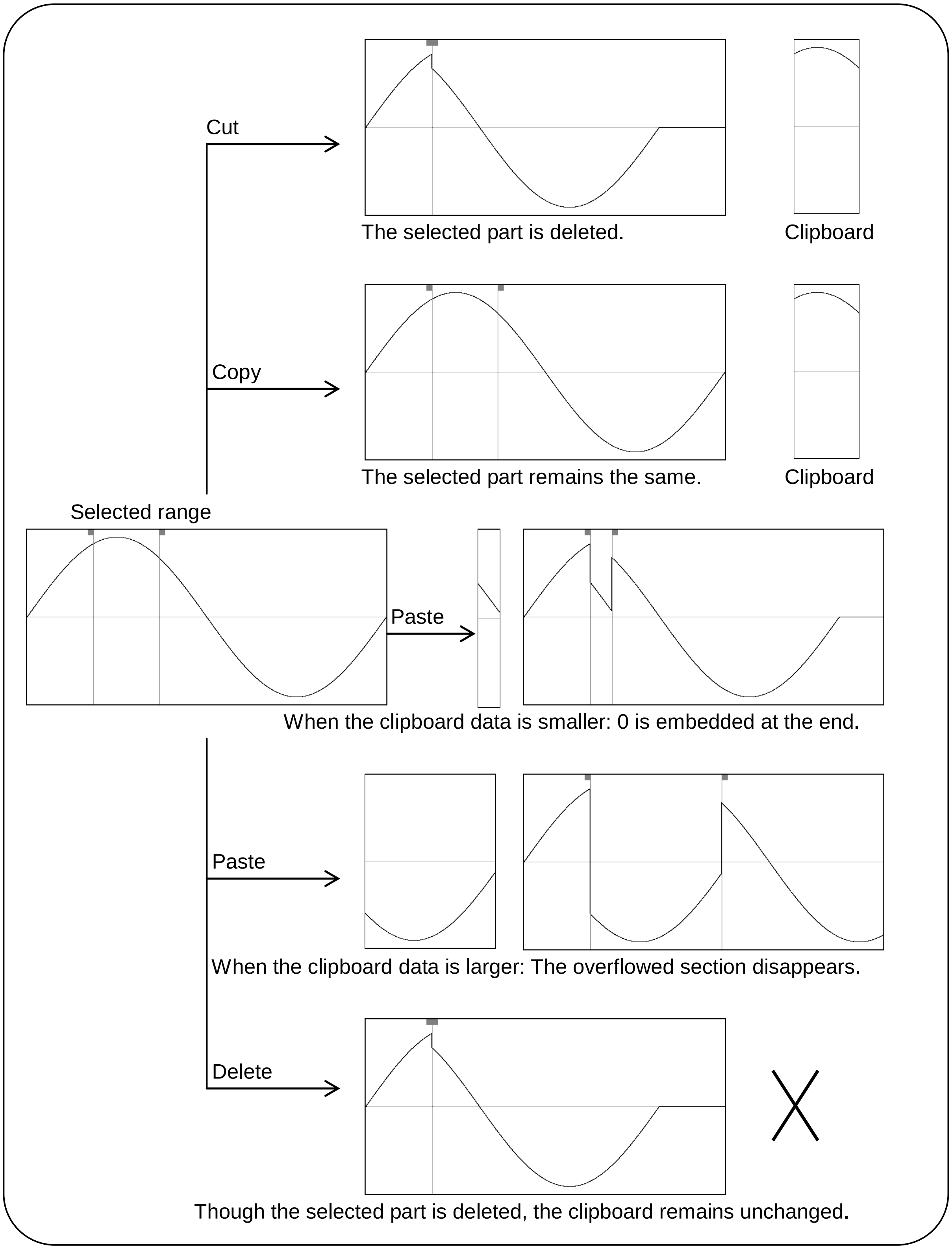


Figure 7-2 Waveform Editing Operation

8. ARBITRARY WAVEFORM – OTHER SCREEN OPERATIONS

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

How to start each screen ☞ **"7.1 Organization and Functions of Waveform Display Screen" (toolbar description)**

☞ **"7.2 Tool Menu"**

8.1 Generation of Standard Waveform and Numerical Expression Waveform

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

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

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

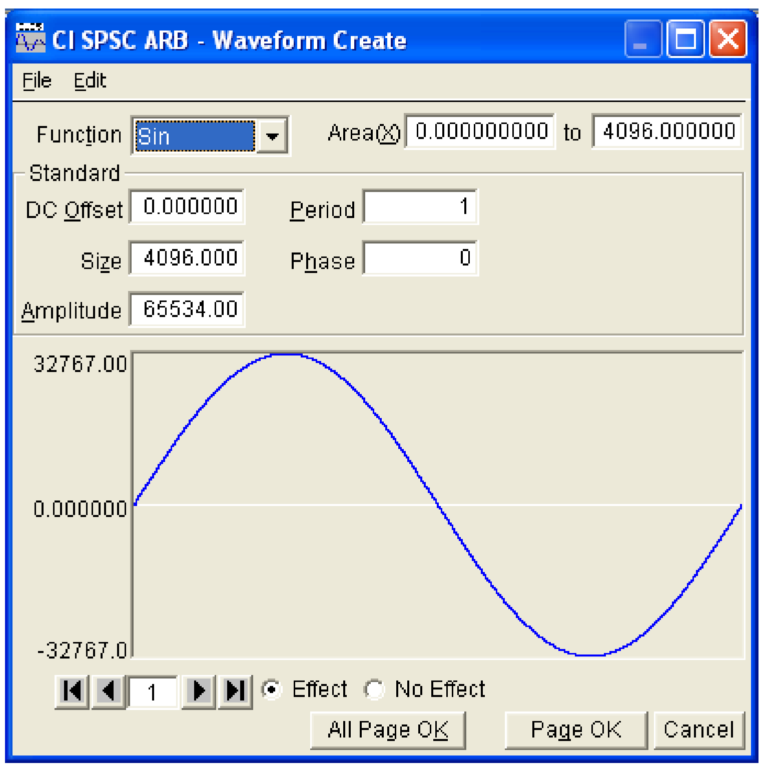


Figure 8-1 Waveform Generation Screen

8.1.1 Range setting and page

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

Set the range for each page in the two numerical input areas to the right of **[Range(X)]**.
If there are duplicated ranges for multiple pages, the waveform definition for a larger page number (later one) takes effect. Using this characteristic, it is possible to change on the later page the part of the waveform defined on one of the first pages.
Each page can be independently enabled or disabled. Click either ○ (option button) in **[○ Enabled]** or **[○ Disabled]** to the bottom of the screen to make it ◉ (selected status).

To move the page, use the ◀ and ▶ buttons at the bottom left of the waveform generation screen. Clicking the ◀ button moves to the previous page and clicking the ▶ button moves to the next page.
Clicking the |◀ button jumps to the first active page and clicking the ▶| button jumps the last active page.
Directly input a number in the numerical value input area between the buttons and press the Enter key to jump to the specified page. The page numbers range from 1 to 200.

To return the settings on the displayed page to the default values, select **[Edit] - [Page Clear]** (Alt, E, P on the waveform generation screen.
To return all pages to the default values at once, select **[Edit] - [All Page Clear]** (Alt, E, A) on the waveform generation screen.

To create the waveform on the displayed page only, click the Page OK button at the bottom of the screen.
To create waveforms on all pages, click the All Page OK button.
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.
The maximum number of pages is 200.

8.1.2 Waveform selection

Clicking the ▼ button to the right of **[Function]** on the waveform generation screen lists available waveforms. Select a waveform by clicking it.
The waveform can be also selected by pressing Alt + T, selecting **[Function]** and then selecting the ↓ key/ ↑ key (→ key/ ← key).
The noise is generated based on the random number calculation, so different waveform data is created at each generation.
DC makes the specified range the same data.
The waveform function defines the waveform with a numerical expression.

☞ **“8.1.4 Inter-Waveform Numerical Expression”**

8.1.3 Parameter setting

The parameters in "**Table 8-1 Parameters for Standard Waveforms**" can be set for sine waves, triangle waves, square waves, noise, and DC.

Table 8-1 Parameters for Standard Waveforms

	Sine Wave	Triangle Wave	Square Wave	Noise	DC
Offset (O)	○	○	○	○	○
Size (Z)	○	○	○	○	○
Amplitude (A)	○	○	○	○	–
Period (P)	○	○	○	–	–
Phase (H)	○	○	○	–	–
Inclination (M)	–	○	–	–	–
Duty (R)	–	–	○	–	–
Transition (N)	–	–	○	–	–

The size can be calculated by subtracting (lower limit) from (upper limit) of the range specification (X) on the page. When the size is changed, the upper limit of range specification is changed.
The amplitude is the peak to peak value.
The cycle specifies how many cycles (waves) of the waveform in the range are to be created.
The phase unit is ° (degree).
For the triangle wave, the inclination (symmetry) can be set. The inclination unit is %.
For the square wave, the duty ratio and transition can be set. The duty ratio unit is %. The transition sets the time for the wave height value to go between 0% and 100% with the ratio to the cycle (%).

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

When the mouse cursor is moved to the waveform display area on the waveform generation screen, the shape of mouse cursor changes to ✥ or ⤡.
Dragging the mouse in the ✥ status vertically or horizontally moves the waveform. **[Offset]** is changed by vertical operations and **[Phase]** is changed by horizontal operations.
Dragging the mouse in the ⤡ status vertically or horizontally extends or compress the waveform. **[Amplitude]** is changed by vertical extension/compression and **[Period]** is changed by vertical extension/compression.
Using ✥ or ⤡ enables you to intuitively set parameters while looking at the waveform. It is also possible to

roughly make settings in this way and then set a more accurate value by inputting numerical values.

8.1.4 Inter-Waveform Numerical Expression

Selecting **[Waveform Function]** in “**8.1.2 Waveform selection**” displays the constant input section **[Constant]** and numerical expression input section **[Y=]**.

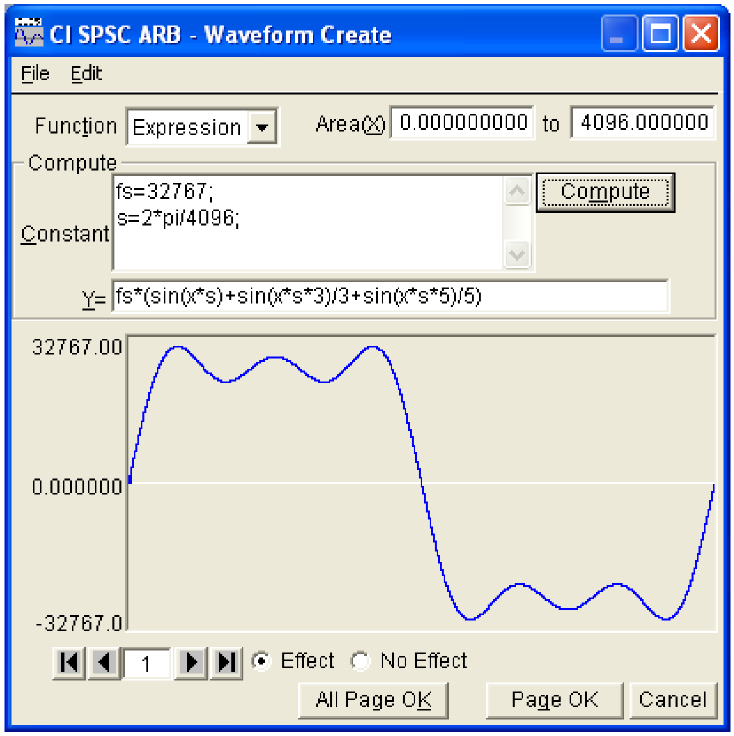


Figure 8-2 Waveform Generation Screen - Waveform Function

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

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

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

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

a) Constants

Describe the constant in the **[constant=value or expression]** format such as **[fs=32767;]** and **[s=2*pi/4096;]**.

Be sure to suffix a constant definition or expression with **[;]**.

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

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

Constants must be strings other than those shown in "**Table 8-4 Built-in Function**". It is recommended to use strings different from those in "**Table 8-2 Built-in Constants**".

When the All Page OK button is clicked, the constant takes effect on the page where the constant is defined and subsequent pages.
For example, the constant defined on the first page affects all the pages. The constant defined on the third page affects the third and subsequent pages, but not the first and second pages.
When the waveform on the displayed page is created with the Page OK button, the constant affects the displayed page only. For example, the constant defined on the second page does not affect the first and third pages.
To use the constant on other pages, click the Compute button to execute calculation on the page where the constant is defined in advance.

b) Built-in constants

The constants shown in "**Table 8-2 Built-in Constants**" were included into "SPSC ARB" at factory.
If the constant defined in "a) constant" has the same name as the built-in constant, the defined value or expression takes effect.

Table 8-2 Built-in Constants

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

c) Functions

Specify a numerical expression in the Y=f (X) format in the numerical expression input section **[Y=]**.
Here, "X" is a value that varies within the range of the page. For example, when the page range is 1000 to 2000, **[X]** in the expression changes between 1000 and 2000.

The **[X]** value in the numerical expression is affected by the horizontal axis unit of the system setting screen settings. ☞ **"8.5.5 Horizontal axis unit"**
For example, assume that expressions such as **[Y=]** or **[sin (x)]** are used to specify a sine wave. The argument for the sin() function is a radian expression.
Assume that the horizontal axis unit is **[Address]** and the range is between 0 and 8,192. Because 8,192 =

2*π*1303.797..., the result of this expression is a sine wave with approximately 1,304 waves.
When the horizontal axis unit is **[Time]** and the cycle is 1 ms, the result of the expression will be 1e-3 = 2*π*0.0001591..., a value that barely changes around the 0° of sine wave.
If the vertical axis unit is **[User unit]** and 0 to 1, the result of the expression will be 1 = 2*π*0.1591..., waveform of about one/sixth of the former half of sine wave.
To create the simplest expression to obtain one cycle of a sine wave, set the horizontal axis unit to **[User unit]** and the range between 0 and 6.283185.

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

☞ **"8.5.6 Vertical axis unit"**

For example, assume that expressions such as **[Y=]** or **[sin (x)]** are used to specify the sine wave. The value for the sin() function is ±1.
When the vertical axis unit is **[Data]**, the range is between –32768 and +32767. Therefore, the result of this expression is a waveform with a very small amplitude close to 0.
When the vertical axis unit is **[Voltage]** and the amplitude is 20 Vp-p, the range is ±10, so the result of this expression is 1/10 of a full-scale sine wave.

When the vertical axis unit is **[User unit]** and the range is between –1 and +1, the result of this expression is a full-scale sine wave.
If the calculation results exceed the ± full-scale range, the waveform is clipped at the ±full-scale range.

d) Operators

The operators in "**Table 8-3 Operators**" can be used in the constant input section **[Constant]** and numerical expression input section **[Y=]**.
The order of operator priority ranges from top (highest) to bottom (lowest).
The logical operator returns 1 when the condition is true and 0 when the condition is false.

Table 8-3 Operators

Operator	Associativity	Remark
( ), function, constant, user-defined variable, numerical string	→	
+ - !	←	Monadic operator, ! is a logical operator
^	→	Binary operator, exponential
* /	→	Binary operator, multiplication/division
+ -	→	Binary operator, addition/subtraction
< <= > >=	→	Logical operator, size comparison
== !=	→	Logical operator, Equivalence comparison

&&	→	Logical operator, AND
||	→	Logical operator, OR

e) Built-in functions

The functions shown in "**Table 8-4 Built-in Function**" can be used in the numerical expression input section **[Y=]** in the "SPSC ARB".

The argument for the trigonometric function is a radian expression.

Power() and phase() are functions that specify the real part in expression 1 and the imaginary part in expression 2 and return the size or declination of a complex vector.

tri() is a function that specifies the angle in expression 1 and the inclination in expression 2 to define the triangle wave. Expression 2 can be omitted. When omitted, an inclination of 50% is used.

sqw() is a function that specifies the angle in expression 1, the duty ratio in expression 2, and the transition in expression 3 to define the square wave. Expression 2 and expression 3 can be omitted. When omitted, a duty ratio of 50% and a transition of 0% are used. However, expression 2 must be specified when expression 3 is specified.

rnd() is a function that defines noise without using an expression.

Table 8-4 Built-in Functions

sin(expression) cos(expression) tan(expression) atn(expression)
sqr(expression) exp(expression) log(expression)
power(expression_1,expression_2) phase(expression_1,expression_2)
tri(expression_1,expression_2) sqw(expression_1,expression_2,expression_3) rnd()

f) Inter-waveform numerical expression examples

Some sample inter-waveform numerical expressions are shown below.

In an example where there is only one page, the range is the whole horizontal axis range and description is omitted.

- One cycle of sine wave (horizontal axis unit: addresses 0 to 4096, vertical axis unit: data ±32767)

  Page 1**[Constant]** **[fs=32767;]** **[Y=] [fs*sin(x*s)]**
  [s=2*pi/4096;] ← 4,096 addresses are regarded as 2π.

- One cycle of sine wave (horizontal axis unit: time 0 to 1 ms, vertical axis unit: voltage ±10V)

  Page 1**[Constant]** **[fs=10;]** **[Y=] [fs*sin(x*s)]**
  [s=2*pi/1e-3;] ← 1 ms is regarded as 2π.

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

  Page 1**[Constant]** **[s=2*pi;]** **[Y=] [sin(x*s)]**

- One cycle of sine wave (horizontal axis: user unit 0 to 6.283185, vertical axis: user unit –1 to +1)
  Page 1 **[Constant]** **[None]** **[Y=] [sin(x)]**

- One cycle of square wave (horizontal axis: user unit 0 to 6.283185, vertical axis: user unit –1 to +1)
  Page 1 **[Constant]** **[None]** **[Y=] [((sin(x)>=0)-0.5)*2]**
  (Obtain 0/+1 square wave using the logical operator “>=” and convert it to ±1.)

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

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

- DSB waveform (horizontal axis: user unit 0 to 6.283185, vertical axis: user unit –1 to +1)
  Page 1 **[Constant]** **[a=19.5;]** **[Y=] [(sin(a*x)+sin(b*x))/2]**
  [b=20.5;]

- CR charge-discharge waveform (horizontal axis: user unit 0 to 1, vertical axis: user unit –1 to +1)
  Page 1 **[Range(X)]** **[0]** to **[0.5]**
  [Constant] **[j=15;]** **[Y=] [1-2*exp(-x*j)]**
  Page 2 **[Range(X)]** **[0.5]** to **[1]**
  [Y=] [-1+2*exp(-(x-0.5)*j)]

- Differentiation waveform (horizontal axis: user unit 0 to 1, vertical axis: user unit –1 to +1)
  Page 1 **[Range(X)]** **[0]** to **[0.5]**
  [Constant] **[j=15;]** **[Y=] [exp(-x*j)]**
  Page 2 **[Range(X)]** **[0.5]** to **[1]**
  [Constant] **[None]** **[Y=] [-exp(-(x-0.5)*j)]**

- Magnetic head waveform: Gaussian pulse (horizontal axis: user unit –1 to 1, vertical axis: user unit –1 to +1)
  Page 1 **[Range(X)]** **[–1]** to **[0]**
  [Constant] **[j=32;]** **[Y=] [exp(-((x+0.5)^2)*j)]**
  Page 2 **[Range(X)]** **[0]** to **[1]**
  [Constant] **[None]** **[Y=] [-exp(-((x-0.5)^2)*j)]**

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

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

Page 1	**[Range(X)]**	**[0]** to **[1]**	
	[Constant]	**[s=2*pi;]**	**[Y=] [sin(s*x)]**
Page 2	**[Range(X)]**	**[0.49]** to **[0.51]**	
	[Constant]	**[j=50;]**	**[Y=] [sin(s*x)+cos(s*j*x)/2+0.5]**

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

- Sin(X)/X waveform (horizontal axis unit: address 0 to 2048, vertical axis unit: data ±32767)

Page 1	**[Range(X)]**	**[0]** to **[2048]**	
	[Constant]	**[fs=32767;]**	**[Y=] [fs*sin((x-s)/k)/((x-s)/k)]**
			[s=2048;]
			[k=174;]
Page 2	**[Range(X)]**	**[2049]** to **[3072]**	
	[Constant]	**[None]**	**[Y=] [32767]**
Page 3	**[Range(X)]**	**[3073]** to **[4096]**	
	[Constant]	**[None]**	**[Y=] [fs*sin((x-s)/k)/((x-s)/k)]**

8.1.5 File operation

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

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

Select a saving location, input a file name and click the Save button. The file extension is ".wfn" and can be omitted at file name input.

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

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

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

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

Other files that SPSC ARB can handle☞ **"7.6.1 File type"**

8.1.6 Print

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

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

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

8.2 Contraction/Extension of Waveform

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

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

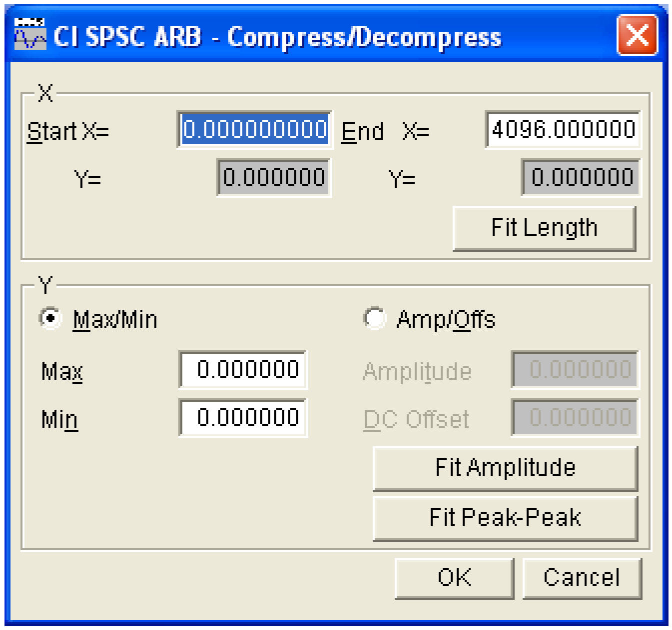


Figure 8-3 Contraction/Extension Screen

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

☞ **"7.4 Undo and Redo"**

8.2.1 Contraction/extension of horizontal axis

Select the range with the markers on the waveform display screen before contracting/extending the horizontal axis. ☞ **"7.5.6 Range selection"**

Contraction/extension of the horizontal axis can be set in the contraction/extension screen **[X axis]** area.

a) Using the selected range as the contraction/extension start/end points

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

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

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

b) Extending the selected range to the full size

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

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

c) Miscellaneous

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

8.2.2 Contraction/extension of vertical axis

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

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

☞ **"7.5.6 Range selection"**

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

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

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

Input the maximum/minimum values of the target after contraction/extension in each display section and press the Enter key to change the waveform on the waveform display screen. If the waveform is hidden behind the contraction/extension screen and difficult to see, move the screen.

The waveform can be vertically inverted by setting a value smaller than the minimum value to the maximum value.

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

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

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

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

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

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

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

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

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

c) Extending the selected range to the maximum amplitude

Click the Fit Peak-Peak button to extend the range selected with the markers to the maximum amplitude. If the selected range offset is not 0 before extension, it changes to 0 after extension.

Click the Fit Amplitude button to extend the positive or negative peak to the maximum value without changing the offset.

d) Miscellaneous

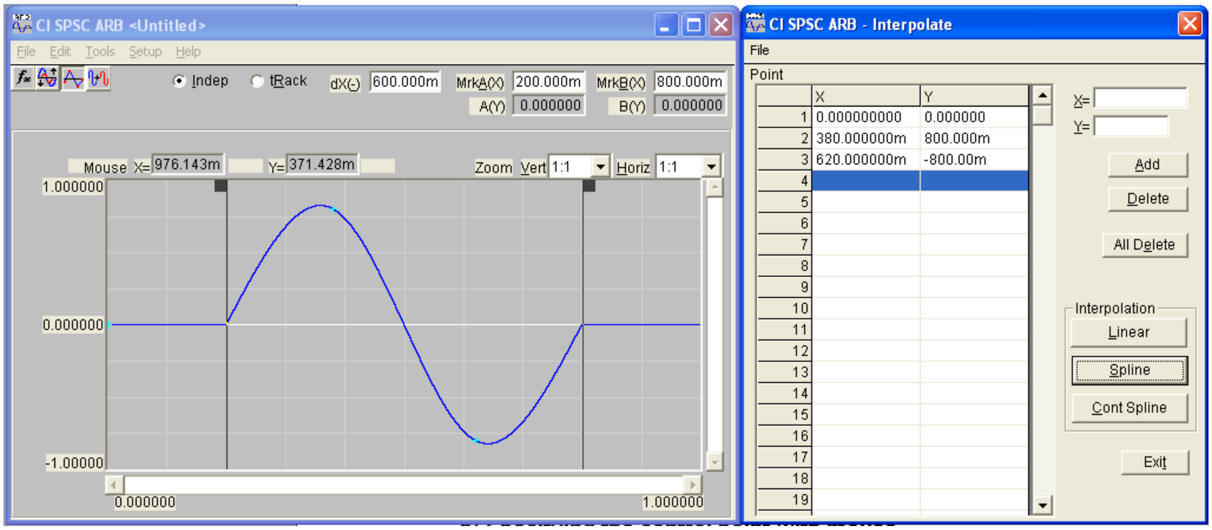
When the setting results in extension that exceeds the ± full scale range, waveforms are clipped at the ±full scale range.

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

8.3 Waveform Generation Through Interpolation

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

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



(Waveform display screen) Interpolation editing screen

Figure 8-4 Interpolation Editing Screen

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

8.3.1 Control point setting

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

Although control points can be set outside the selected range, they will be ignored in the actual interpolation.

a) Specifying the control point with a numerical value

Input numerical values in the input areas to the right of **[X=]** and **[Y=]** on the interpolation editing screen.

To activate the input area to the right of **[X=]**, click the input area or press Alt + X.

To activate the input area to the right of **[Y=]**, click the input area or press Alt + Y.

Click the Add button to display a **[+]** mark at the specified position in the waveform display area. Furthermore, the control point position is displayed with a numerical value in the control point chart on the interpolation editing screen. The chart is arranged from the lowest to highest X values.

b) Specifying the control point with mouse

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

Move the mouse cursor to a desired location for adding a control point and click while holding down the Ctrl key to add a control point. The newly added control point will be in the selected status and displayed in red.

c) Moving the interpolation control point with a numerical value

When one of the control points listed on the interpolation editing screen is clicked, the clicked control point is selected and the following processing is performed.

- The specified portion of the chart is highlighted.

- The input areas to the right of **[X=]** and **[Y=]** displays the position of the selected control point.
- The corresponding **[+]** mark on the waveform display screen is displayed in red.

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

With the control point selected, update the numerical values in the input areas to the right of **[X=]** and **[Y=]** input area and click the Add button to move the selected control point.

d) Moving the control point with mouse

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

e) Deleting the control point

Click the Delete button to delete the selected control point.

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

f) Deleting all the control points

Click the Delete All button to select all the set control points.

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

8.3.2 Interpolation

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

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

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

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

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

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

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

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

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

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

8.3.3 File operation

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

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

Select a saving location, input a file name and click the Save button. Select a file extension from ".prn", ".tsv", and ".csv" so that it will not be necessary to specify it during file name input.

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

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

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

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

Other files that can be handled with the SPSC ARB ☞ **"7.6.1 File type"**

8.4 Operation Between Waveforms

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

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

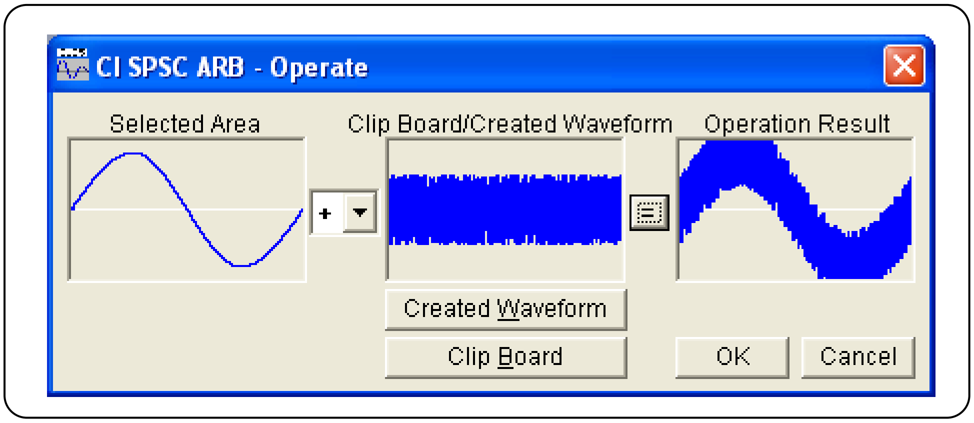


Figure 8-5 Inter-Waveform Operation Screen

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

Inter-waveform operations are in the selected range. Select the range beforehand on the waveform display screen with markers A and B.

8.4.1 Operation types

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

Select an operator by clicking the item in the list or pressing the ↑ ↓ → ← keys.

Note that **[*]** indicates multiplication (×) and **[/]** indicates division (÷).

8.4.2 Object of operation

a) Waveform generation

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

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

Create a waveform referring to "**8.1 Generation of Standard Waveform and Numerical Expression Waveform**" and click the Page OK button. The created waveform is displayed in the **[Clip Board/Created Waveform]** area.

b) Clipboard

Clicking the Clip Board button or pressing Alt + B displays the waveform stored on the clipboard in the **[Clip Board/Created Waveform]** area. Clipboard: ☞ **"7.7.2 Clipboard"**

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

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

8.4.3 Operation execution

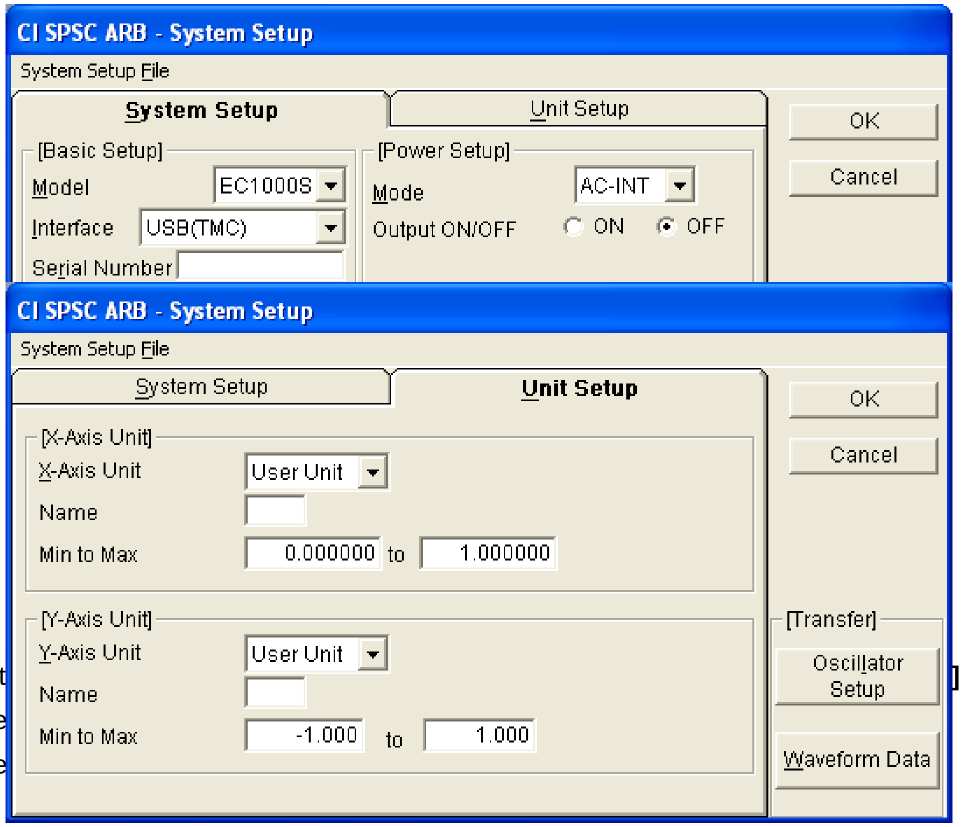
Clicking the $\boxed{=}$ button displays the result of inter-waveform operation in **[Operation Result]**.
Click the $\boxed{\text{OK}}$ button to return to the waveform display screen and reflect the operation result.
Click the $\boxed{\text{Cancel}}$ button or press the $\boxed{\text{Esc}}$ key to return to the waveform display screen without performing any operation.

It is recommended to set the vertical axis unit to the user unit: –1 to +1, especially when executing multiplication in inter-waveform operation.
Under this setting, the result of multiplying ± full scale values can be a ± full scale value.
When the operation result exceeds the ± full scale scale value, waveforms are clipped at the ± full scale value.

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

8.5 Transferring the Waveform and Settings

The system setting screen is used to set the device model, interface, and main parameters.
This screen is also used to transfer the signal generator settings or waveform data to the device.
In addition, the vertical/horizontal axis unit displayed on the waveform display screen can be set on this screen.
Select **[Setup] - [System Setup]** (Alt, S, S) to open the system setting screen.



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8.5.1 Model setting

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

a) Selecting the target model

Click the ▼ button to the right of **[Model]** to display the list of supported signal generator models.
Click one in the list or press the ↑ ↓ → ← keys to select a model.
The setting item and settable range in **[Waveform Memory Setting]** and **[Power Setting]** vary depending on the selected model.
The selected model is saved even after the SPSC ARB is exited and the same setting applies at the next startup.

b) Interface selection

Click the ▼ button to the right of **[Interface]** to display the list of supported interfaces.
Click one in the list or press the ↑ ↓ → ← keys to select an interface.
The selected interface is saved even after the SPSC ARB is exited and the same setting applies at the next startup.

c) Serial number setting

If USB (TMC) is selected in **[Interface]**, the serial number can be set.
Set the serial number for the device to be connected in the text input field to the right of **[Serial Number]**.
Check the device to be connected for its serial number.
In the EC1000S, the set serial number should be a 7-digit numerical value.

8.5.2 Waveform memory setting

The **[Wavememory setup]** frame on the **[System Setup]** page is used to set the waveform memory size, waveform memory name, and waveform memory number. Some signal generator models have items that cannot be set.

a) Waveform memory size

Click the ▼ button to the right of **[Memory Size]** to display the list of selectable waveform memory sizes.
Click one in the list or press the ↑ ↓ → ← keys to select a size.

The selected waveform memory size is saved even after the SPSC ARB is exited and the same setting applies at the next startup.
In the EC1000S, the waveform memory size cannot be selected.

b) Waveform memory name

Input a waveform memory in the area to the right of **[Memory Name]**.
In the EC1000S, the waveform memory name cannot be selected.

c) Waveform memory number

Click the ▲▼ button to the right of **[Memory Number]** to select a waveform memory number.
Click ▼ to increase the memory number and click ▲ to decrease the memory number.
It is also possible to directly input a numerical value in the numerical value display area.

8.5.3 Signal generator setting

The **[Power Setup]** frame in the **[System Setup]** page is used to set the device mode, output on/off, frequency (cycle), output range, amplitude, and DC offset.
The relationship between the signal generator models and settable items is shown in “**Table 8-5 Device Setting Item**”.

Table 8-5 Device Setting Items

	EC1000S
Mode	○ (AC-INT, AC-ADD, ACDC-INT, ACDC-ADD only)
Output on/off	○
Frequency	○
Cycle	○
Output range	○
Amplitude	○
DC offset	○ (ACDC-INT, ACDC-ADD only)

In the frequency, cycle, amplitude, and DC offset, 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}), and a (10^{-18}) can be added after the number.

The power setting is initialized after the next startup after SPSC ARB is exited or an additional SPSC ARB is started.

a) Mode

Click the ▼ button to the right of **[Mode (M)]** to display the list of selectable modes.

Click one in the list or press the ↑ ↓ → ← keys to select a mode.

b) Output on/off

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

c) Frequency

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

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

If the frequency currently set exceeds the actual upper limit of an arbitrary waveform, a warning message appears.

The actual upper limit of an arbitrary waveform and the settable range of the frequency differ depending on the signal generator model.

d) Period

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

Changing the cycle setting also updates the frequency display.

If the frequency currently set exceeds the actual upper limit of an arbitrary waveform, a warning message appears.

The actual upper limit of an arbitrary waveform and the settable range of the cycle differ depending on the signal generator model.

e) Range

Click the ▼ button to the right of **[Range]** to display the list of selectable output ranges.
Click one in the list or press the ↑ ↓ → ← keys to select an output range.

f) Amplitude

Click the input area to the right of **[Amplitude]** or press Alt + A to activate the input area. Input a numerical value at this status and press the Enter key to determine the value.
The settable range of amplitude differs depending on the output range.
In addition, the amplitude and DC offset settings put restrictions on each other, so an error may occur when device settings are transferred via USB. Read the device manual and make settings so that no error occurs.

g) DC offset

Click the input area to the right of **[DC Offset]** or press Alt + O to activate the input area. Input a numerical value at this status and press the Enter key to determine the value.
In addition, the amplitude and DC offset settings put restrictions on each other, so an error may occur when device settings are transferred via USB. Read the device manual and make settings so that no error occurs.

8.5.4 Transferring data

a) Transferring data

Clicking the Oscillator Setup button or pressing Alt + L transfers the settings in the **[Power setting]** frame to the device.
Clicking the Waveform Data button or pressing Alt + W transfers the created waveform data to the device and outputs the waveform.

b) Notes on USB

- Data cannot be transferred unless the driver software is installed normally.

☞ **“2.2.1 Installing the USB driver software”**

- Do not perform any operation using the SPSC ARB during data transfer.
- If the connected device is different from the set device or the serial number is different, an error occurs. Check the setting.
- Even when multiple SPSC ARBs are running, it is not possible to transfer data from multiple SPSC ARBs at the same time.

8.5.5 Horizontal axis unit

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

The time is interlocked with **[Frequency]** and **[Period]** in **[Power Setup]**.
From the head to the tail of waveform data, that is, one cycle corresponds to **[Period]** in **[Power Setup]**.
For example, this function is useful when creating a waveform through interpolation by setting the voltage to the vertical axis and the time to the horizontal axis.
In the user unit, any values can be set to the beginning and end of waveform data as well as the unit name.
Several examples in the user unit of the horizontal axis are shown in "**Table 8-6 Examples of User Units for the Horizontal Axis**".
When a numerical expression is used to generate a waveform, it is useful to use the 0 to 6.283185 radian units because trigonometrical functions such as sin() are in radian units.

Click **[Unit Setup]** tab on the system setting screen or Alt + U to activate the **[Unit Setup]** page.
Click the ▼ button to the right of **[X-Axis Unit]** to display the list of selectable horizontal axis units.
Click one in the list or press the ↑ ↓ → ← keys to select a horizontal axis unit.
When the user unit is selected as a horizontal axis unit, **[Name]**, **[Min to Max]** can be set.
Input a string consisting of up to four 1-byte characters (or two 2-byte characters) as the name of the horizontal axis unit in the area to the right of **[Name]**.
Input numerical values for the minimum value (leftmost value of waveform) and maximum value (rightmost value of waveform) for the user unit in the areas to the right of **[Min to Max]**.

Table 8-6 Examples of User Units for the Horizontal Axis

Range	Name (Explanation)
0 to 1	cycle
−1 to 1	(Use this to align with the vertical axis range when the user unit for the vertical axis is ±1.)
0 to 360	degrees (°)
0 to 400	grads
0 to 6.283185	radians

8.5.6 Vertical axis unit

In the SPSC ARB, the voltage and the user unit can be used as the display/setting unit of vertical axis in addition to the waveform data (16 bits: −32768 to +32767).

The voltage is interlocked with **[Amplitude]** and **[DC Offset]** in **[Power Setup]**.
For example, this function is useful when creating a waveform through interpolation by setting the voltage to the vertical axis and the time to the horizontal axis.
In the user unit, any value can be set at the beginning and end of waveform data as well as the unit name.
When a numerical expression is used to generate a waveform, it is useful to use −1 to +1 because the

maximum value of trigonometrical functions such as sin() is ±1.

Click the **[Unit Setup]** tab on the system setting screen or press Alt + U to activate the **[Unit Setup]** page.
Click the ▼ button to the right of **[Unit(X)]** to display the list of selectable vertical axis units.
Click one in the list or press the ↑ ↓ → ← keys to select a vertical axis unit.
When the user unit is selected as a vertical axis unit, **[Name]**, **[Min to Max]** can be set.
Input a string consisting of up to four 1-byte characters (or two 2-byte characters) as the name of the vertical axis unit in the area to the right of **[Name]**.
Input numerical values for the minimum value (lowermost value of waveform) and maximum value (uppermost value of waveform) for the user unit in the areas to the right of **[Min to Max]**.

8.5.7 File operations

The settings for the system setting screen are saved to a file or read from a file.
The system setting file for the SPSC ARB is a binary file in a unique format and cannot be used in other applications.

Select **[System Setup File] - [Save]** (Alt, F, S or Ctrl + S) on the system setting screen to display the screen titled **[Save As]**.
Select a saving location, input a file name and click the Save button. The file extension is ".ocb" and can be omitted at file name input.

To read the system setting file, select **[System Setup File(F)] - [Open]** (Alt, F, O or Ctrl + O).
When the screen titled **[Open File]** appears, select a file location, input a file name and click the Open button.

Other files that can be handled with the SPSC ARB ☞ **"7.6.1 File type"**

8.5.8 Print

The setting conditions for the system setting screen can also be printed out.
Select **[System Setup File(F)] - [Print(P)]** (Alt, F, P or Ctrl + P) to display the screen titled **[SPSC ARB - Print]**.
Make settings for the upper, lower and left margins, the printer or font as needed and click the OK button.

The parameters set on the system screen and initialized when the SPSC ARB is started are shown in "**Table 8-7 Initialized Values**".

Table 8-7 Initialized Values

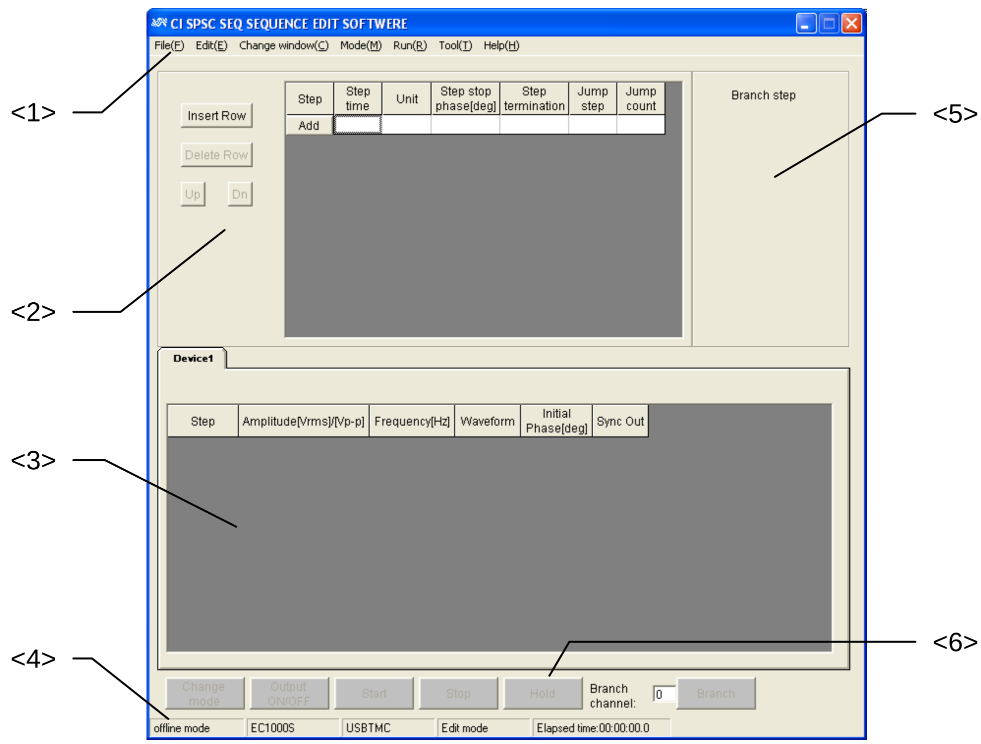
	EC1000S
Waveform memory name	(No specification)
Waveform memory number	1
Channel	–

Output on/off	OFF
Frequency [Hz]	50
Cycle [sec]	20 m
Output range	100 V
Amplitude [Vp-p]	0.0
DC offset [V]	0.0
X axis unit	Address
X axis name	(No specification)
X axis minimum value	0.000000
X axis maximum value	1.000000
Y axis unit	Data
Y axis name	(No specification)
Y axis minimum value	−1.000
Y axis maximum value	1.000

9. SEQUENCE EDITING

9.1 Component Names

The following editing screen appears after the SPSC SEQ Sequence Edit Software (SPSC SEQ) is started.



<1> Menu bar

☞ See “9.2 Menu Organization”.

<2> Common parameters setting area

☞ See “9.3 Sequence Edit Area”.

<3> Sequence execution parameters setting area

☞ See “9.3 Sequence Edit Area”.

<4> Message display area

Displays the demo operation/online, device model name, interface, editing, execution mode, sequence execution time and other information.

☞ See “9.8 Message Display Area”.

<5> Branch step setting area

☞ See “9.4 Sequence Edit Area”.

<6> Sequence control button

☞ See “9.6 Sequence Control Buttons”.

9.2 Menu Organization

The menu organization of the SPSC SEQ Sequence Edit Software is shown below.

Note that items indicated with an asterisk (*) cannot be used in the sequence view window.

Menu	Item	Shortcut	Description
File(F)	New(N)*	Ctrl+N	Clears the sequence data, and initializes it to the condition enabling creation of new data.
	Open(O)*	Ctrl+O	Opens the sequence data file.
	Save(S)	Ctrl+S	Saves the sequence data by overwriting.
	Save As(A)		Saves the sequence data under the specified file name.
	Exit(X)		Exits this software.
Edit(Ｅ)*	Copy(C)	Ctrl+C	Copies the selected sequence data.
	Paste(P)	Ctrl+V	Pastes the copied sequence data.
	Select All(L)	Ctrl+A	Selects all the sequence data contained in the setting area being edited.
	Initialize(A)	Ctrl+I	Changes the selected cell to the initial value.
	Add Row(S)		Adds a new row.
	Insert Row(I)		Adds a new row before the row being edited.
	Delete Row(E)		Deletes the row being edited.
	Row Up(U)		Moves the row being edited to one row above.
	Row Down(D)		Moves the row being edited to one row below.
Change Window(C)	Edit Window (E)		Displays the edit window.
	Sequence View Window*(V)		Displays the sequence view window.
	Tile Vertically(T)		Tiles the edit and sequence view windows.
Mode(M)	Edit mode(E)		Changes to the mode in which the sequence data can be edited.
	Execution mode (R)		Changes to the mode in which the sequence can be executed.
Run(R)	Start(S)		Starts execution of the sequence.
	Stop(E)		Stops execution of the sequence.
	Hold(H)		Holds execution of the sequence.
	Branch(B)		Changes to the step set in the branch channel number.
	Output ON(N)		Turns on output of the device.
	Output OFF(F)		Turns off output of the device.
Tool(T)	Transfer Arbitrary Wave Data(A)		Displays the [Transfer Arbitrary Wave Data] dialog box.
	Clear Arbitrary Waveform Memory(C)		Displays the [Clear Srbitrary Waveform Memory] dialog box.
	Set Mode(M)		Displays the [Set Mode] dialog box.
	System Setup(I)		Displays the [System Setup] dialog box.
Help(H)	About(A)		Displays the [About] dialog box.

9.3 Start and Termination

For how to start the SPSC SEQ Sequence Edit Software, **see “3.2 Starting the Subsoftware”**.

The message in the following figure appears when the software is started for the first time or when the previously set device is not connected.

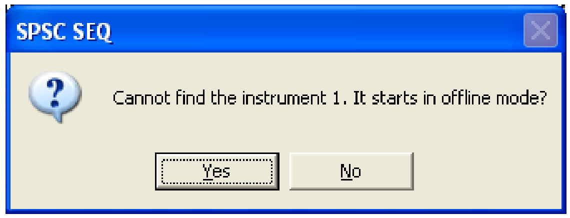


Figure 9-1 Message Displayed When Sequence Edit Software Is Started

When Yes(Y) is clicked the software is started in the offline mode. When No(N) is clicked, the software is not started.

After starting the software, connect the device and make system settings.

☞ **“11.7 System Settings”**

If the above operations are not performed, the device remains in the offline status.

The software is exited when **[File(F)] - [Exit(X)]** is selected or the Close button is clicked.

⚠ **Caution**

The system setting dialog box appears only when the software is started for the first time. For details, ☞ **see “11.7 System Settings”**.

9.4 Sequence Edit Area

The sequence edit area consists of the following three areas.

<1> Common parameters setting area
<2> Sequence execution parameters setting area
<3> Branch step setting area

When the “SPSC SEQ” is started, the previously set values are shown. If the software is used for the first time or a sequence is newly created, the initial set values are shown. (For the initial set values, ☞ **see “11.8 List of Initial Setting Values”**.)
The edit area when the SPSC SEQ is started for the first time is shown in Figure 9-2.
The displayed parameters in the sequence execution parameters setting area vary depending on the operation mode of the Programmable AC/DC Power Source EC1000S.

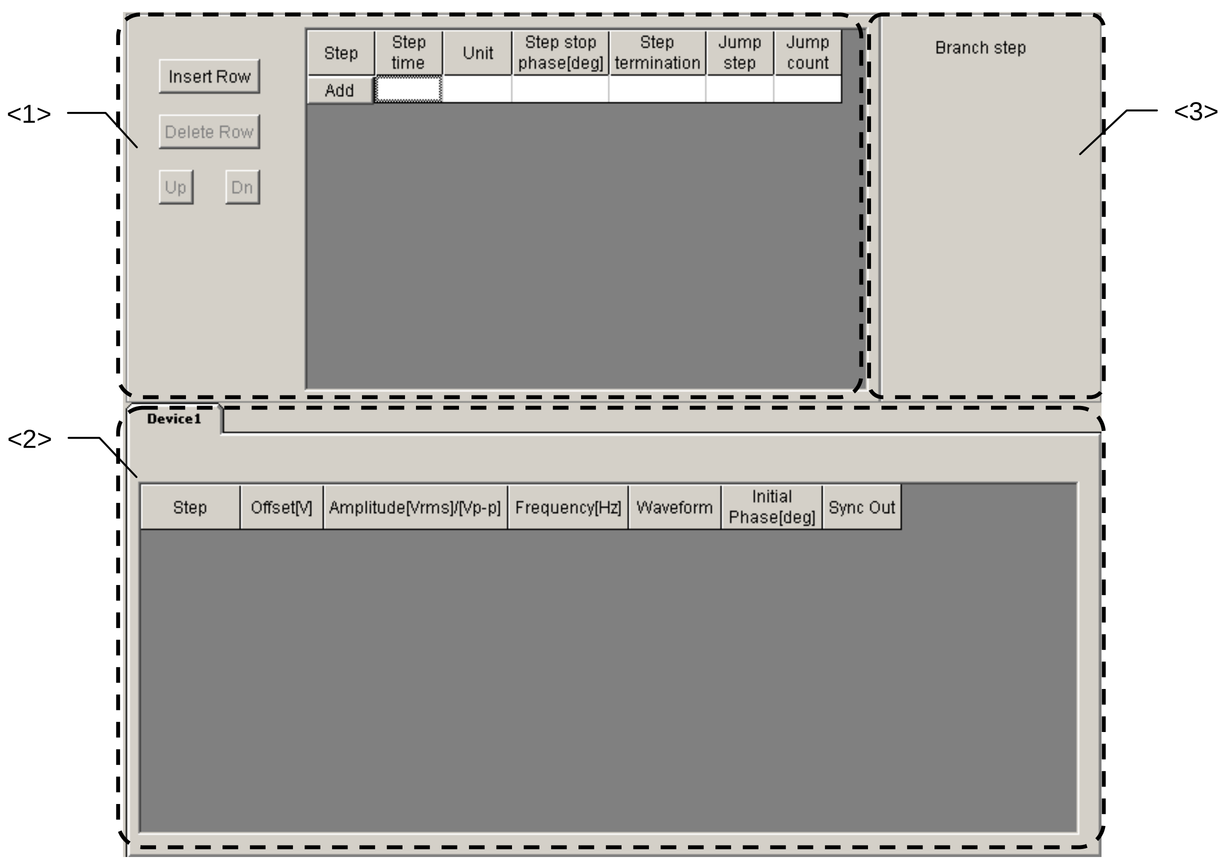


Figure 9-2 Sequence Edit Area

9.4.1 Adding, inserting, deleting, and moving a row

Clicking the Add button ⇛ adds a new row. Default values are shown in the newly added row. The step number is automatically incremented by units of 1.

Clicking the Insert Row button adds a new row immediately before the selected row. Default values are shown in the inserted row.

Clicking the Delete Row button deletes the selected row.

Clicking the Move Row buttons △ and ▽ moves the selected row up or down.

If the jump destination is deleted due to the delete operation, the jump number is set to "0". If the jump destination is changed due to an insert, delete, or move operation, the jump number changes accordingly.

When the Add button ⇛ is clicked twice in the status shown in "**Figure 9-2**", the window will change as follows:

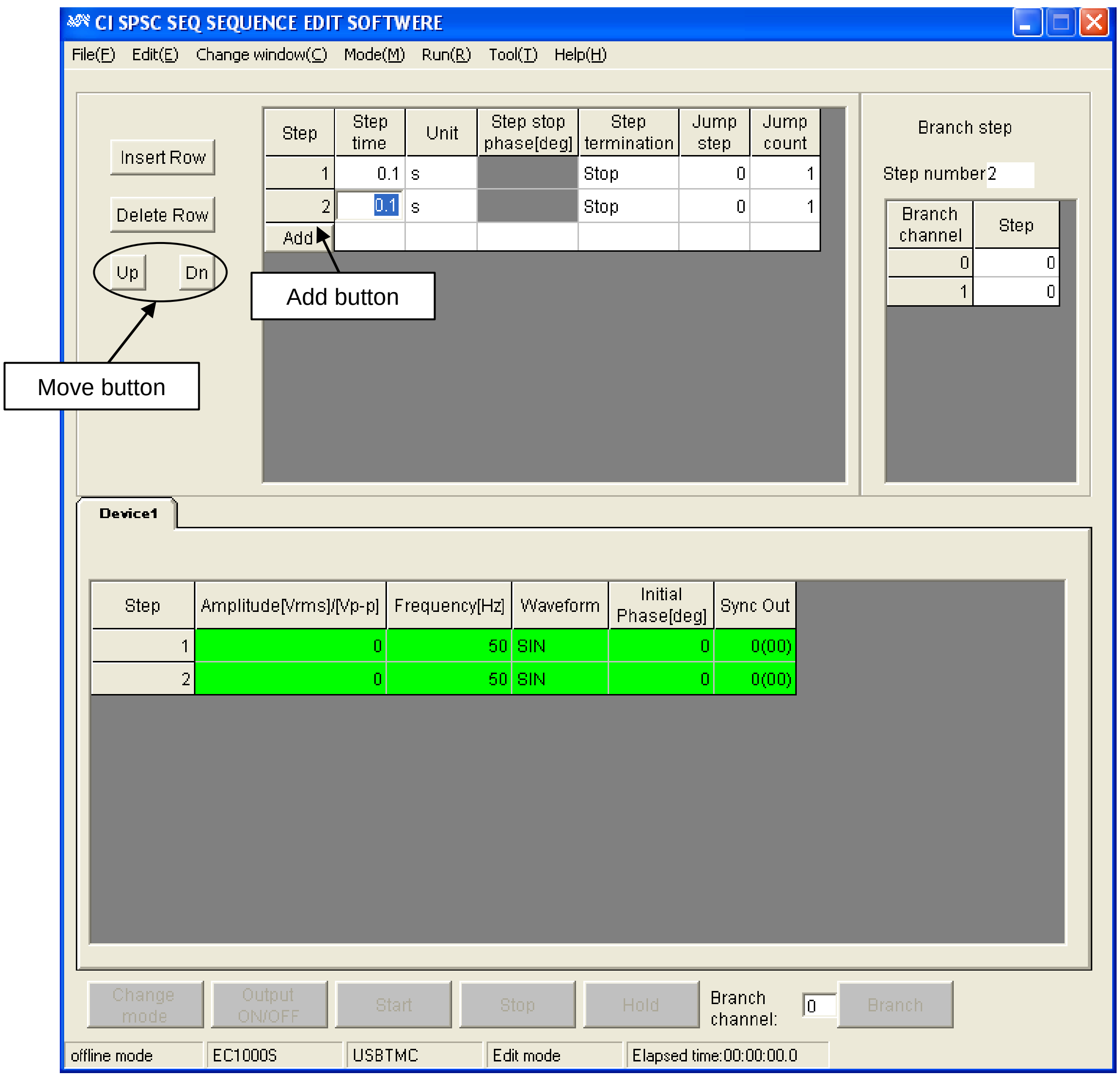


Figure 9-3 Move and Add Buttons

9.4.2 Setting parameters

You can set each parameter by inputting the desired value directly into the selected cell. The input values are checked for range appropriateness.

Selecting **[Edit] - [Initialize]** or pressing Ctrl + I can return the selected set values to the defaults.

To set a value in **[Step termination]**, **[Waveform]**, **[Sync Out]**, or **[Unit]**, click the desired cell and select the value from the combo box as shown in "**Figure 9-4 Combo Boxes**".

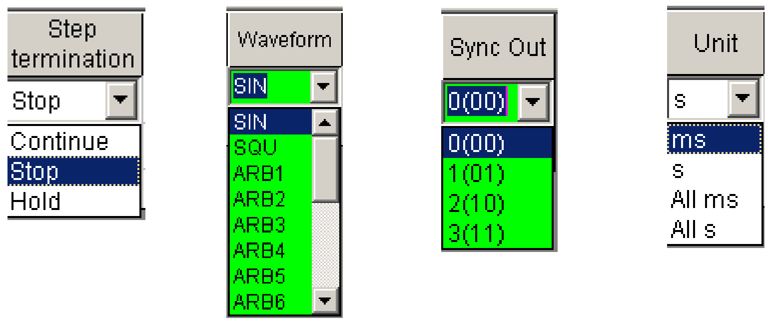


Figure 9-4 Combo Boxes

⚠ **Caution**

- Set **[Stop]** as the terminal for the last step.
- Though a jump number can be set for the step of which "Step termination" is set to Stop, the setting is ignored if Stop is set for "Step termination" and the jump number is valid in other cases (when Stop is set, jump is not executed).
- Jump number 0 indicates that transition to the next step number will take place without jumping.
- Jump count 0 indicates that the jump will repeat infinitely.
- For parameter details, see the **Programmable AC/DC Power Source Instruction Manual**. Note that different terms are used for the same meanings in this software's manual and the Programmable AC/DC Power Source Instruction Manual.

[This software]	[Programmable AC/DC Power Source EC1000S]
End phase	Step end phase
Terminal	Step terminal
Synchronous output	Step synchronous output
Constant	CONST
Retain	KEEP
Sweep	SWEEP
Continue	Continue the sequence
Exit	Move to the Idle status
Hold	Move to the Hold status
Jump number	Jump step

Clicking the **[Step stop phase [deg]]** cell displays the radio buttons with which the stop phase can be enabled or disabled, as shown in "**Figure 9-5**". The stop phase can be enabled or disabled by switching the radio button setting. If Disable is selected, the corresponding cell will gray out and it will not accept any entry. If Enable is selected, the cell will display the default value.

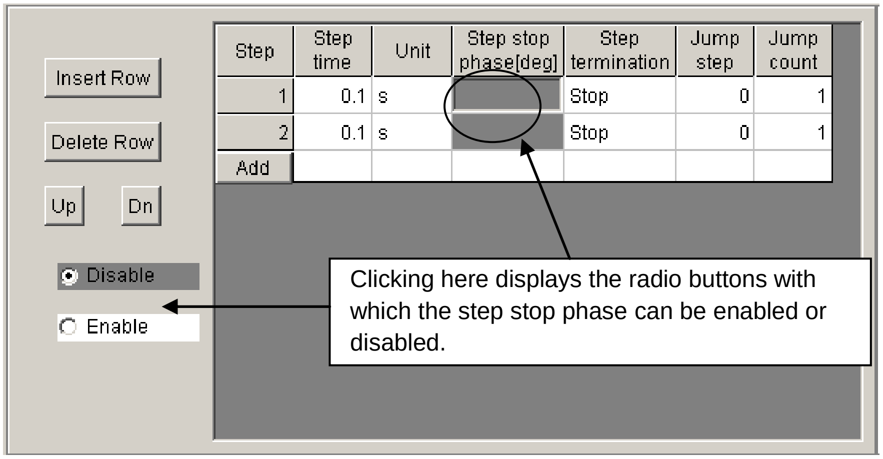


Figure 9-5 Step Stop Phase Setting

Clicking a cell in the sequence execution parameters setting area displays the radio buttons with which the operational types can be set. The operational type can be enabled or disabled by switching the radio button setting.

All cells, except **[Unit]**, in this area are color-coded according to the operational type. The cell color representing each operational type corresponds to one of the background colors of the radio buttons with which this type can be set.

All the parameters for the cells being set to the "Keep" operation type will be ignored.

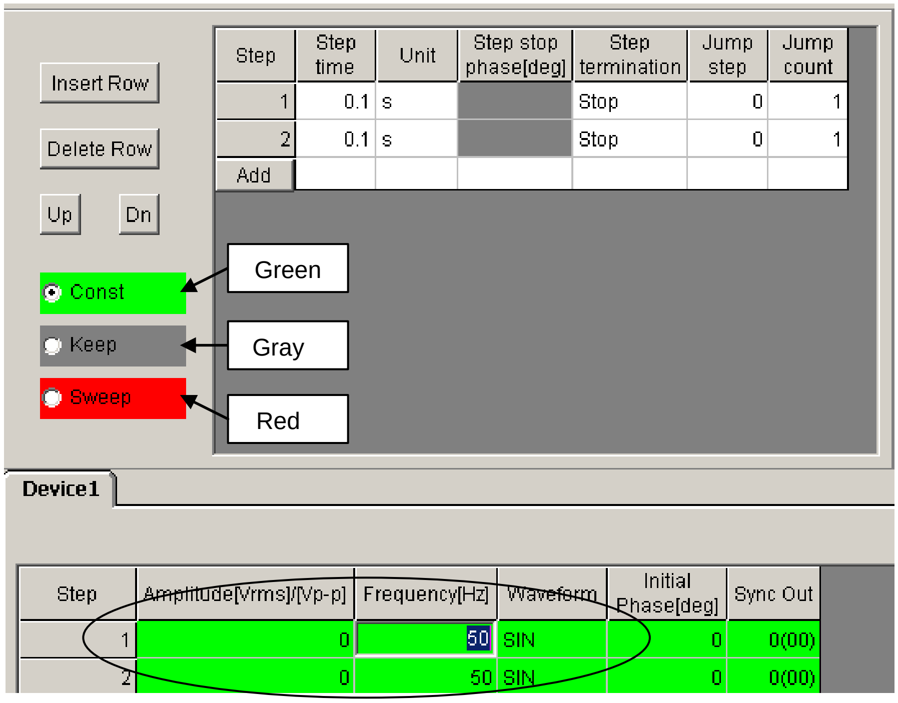


Figure 9-6 Setting the Operational Type

Branch steps can be set respectively for step numbers.

In the common parameters or sequence execution parameters setting area, select the cell of the step number, and then enter the step number for each branch channel.

Clicking the Branch button or entering the sequence branch trigger during execution of the sequence can change the sequence to the appropriate step number.

If the step number of the branch channel is 0, no sequence transition will take place.

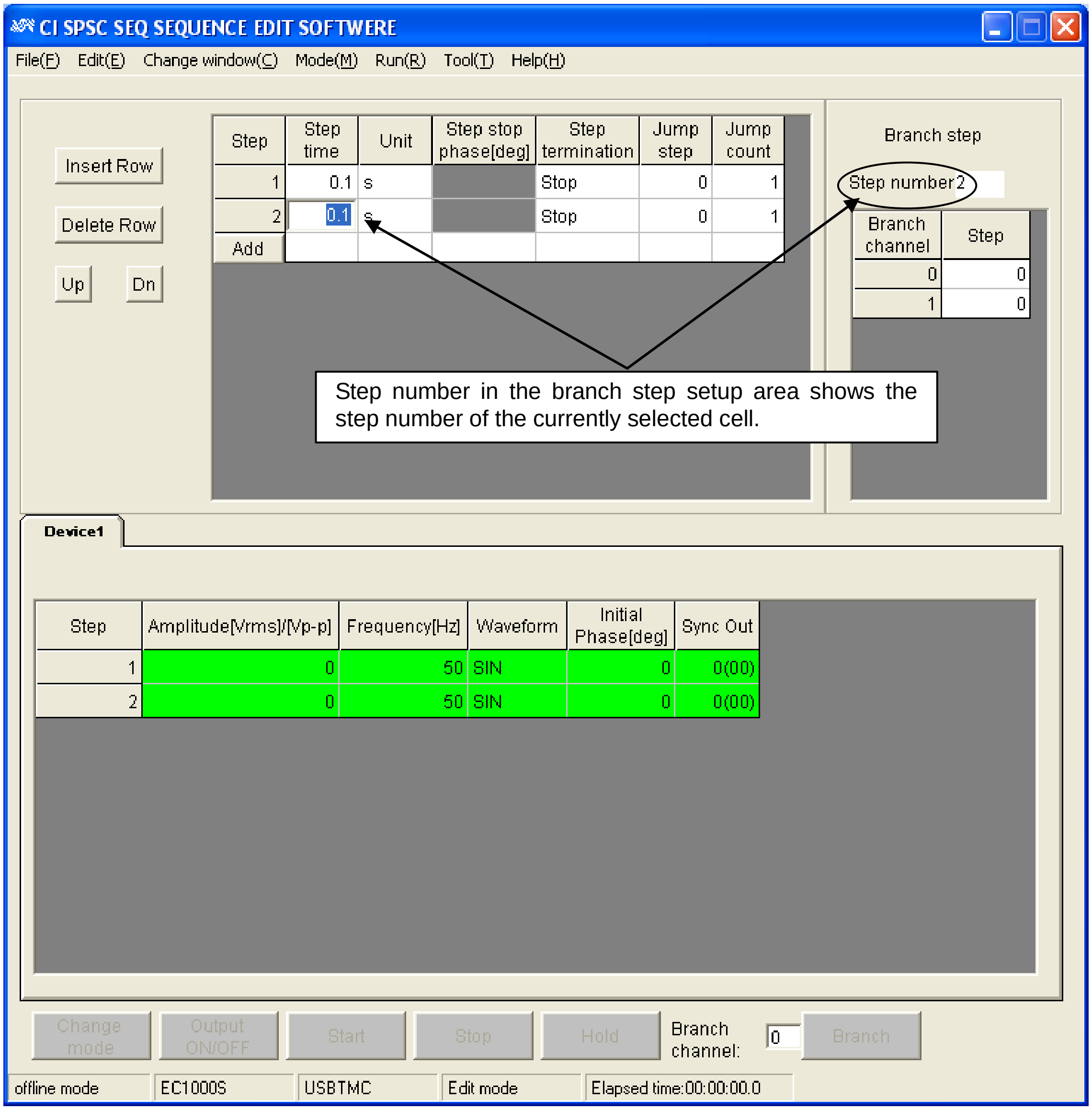


Figure 9-7 Setting the Branch Steps

9.5 Copying the Sequence Data

The sequence data can be copied in either the common parameters or sequence execution parameters setting area.

⚠ **Caution**

Sequence data cannot be copied in the branch step setting area.

Follow the procedure below to copy the sequence data.

<1> Select the sequence data to be copied, including the operational type setting.

<2> Select **[Edit] – [Copy]** to copy the data.

<3> Select the destination.

<4> Select **[Edit] – [Paste]** to paste the data.

Although data can be selected in cell, line, and row units, if the format of the selected data differs from that of the copy destination, paste is not possible. That is, data in one cell or column cannot be copied to a cell or column in another column.

9.6 Sequence Control Buttons

This section details the sequence control buttons.

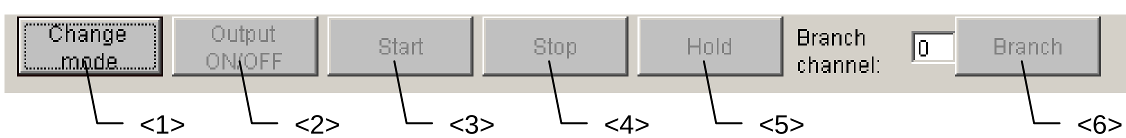


Figure 9-8 Sequence Control Buttons

<1> [Change Mode] button

This button is used to change modes between edit and execution. When the mode is changed, the sequence parameters are transferred to the device. When the **[Output ON/OFF]** button is clicked after transfer, the output waveform changes to one of the following, depending on the waveform specified by the sequence parameter:

Waveform		Output waveform
SIN	…	SIN (sine wave)

SQU	…	SQU (square wave)
ARB	…	ARB1 (arbitrary waveform 1)

While the sequence is running, the mode cannot be changed.

Edit mode:	Allows the sequence data to be edited. Sequences cannot be run in the edit mode.
Execution mode:	Allows the sequence to be executed. Sequences cannot be edited in the execution mode.

<2> [Output ON/OFF] button

This button is used to control output of the device. If the output is turned on, this button turns green. While the sequence is running, it is not possible to change between output ON and OFF.

<3> [Start] button

This button is used to start the sequence. Clicking this button enables the Stop, Hold, and Branch buttons to operate.

If the device output is not on when the Start button is clicked, a message appears prompting that the output will be turned on, followd by the output turning on.

While the sequence is executing, it is not possible to turn on or off the output or exit the software. Click the Stop button before turning on or off the output, or exiting the software.

The last set values of the last step are held when a sequence has completed.

<4> [Stop] button

This button is used to stop the sequence. The output when the sequence is stopped is held. After this button has been pressed, the Stop, Hold, and Branch button will be unavailable. Clicking the Start button in this state can restart the sequence, beginning at step 1.

<5> [Hold] button

This button is used to stop the sequence temporarily. The output when the sequence is paused is held. Clicking the Start button can resume the sequence from a step that has temporally stopped. Click the Stop button to terminate the sequence.

<6> [Branch] button

This button is used to branch the sequence. Clicking the Branch button with a branch channel number entered into the **[Branch Channel]** field moves the sequence to the step currently set in the branch step.

9.7 Monitoring the Sequence Execution

The SPSC SEQ window allows monitoring of how the sequence is being executed.

As shown in “Figure 9-9”, the current step is indicated by a change of color in the common parameters or sequence execution parameters setting area.

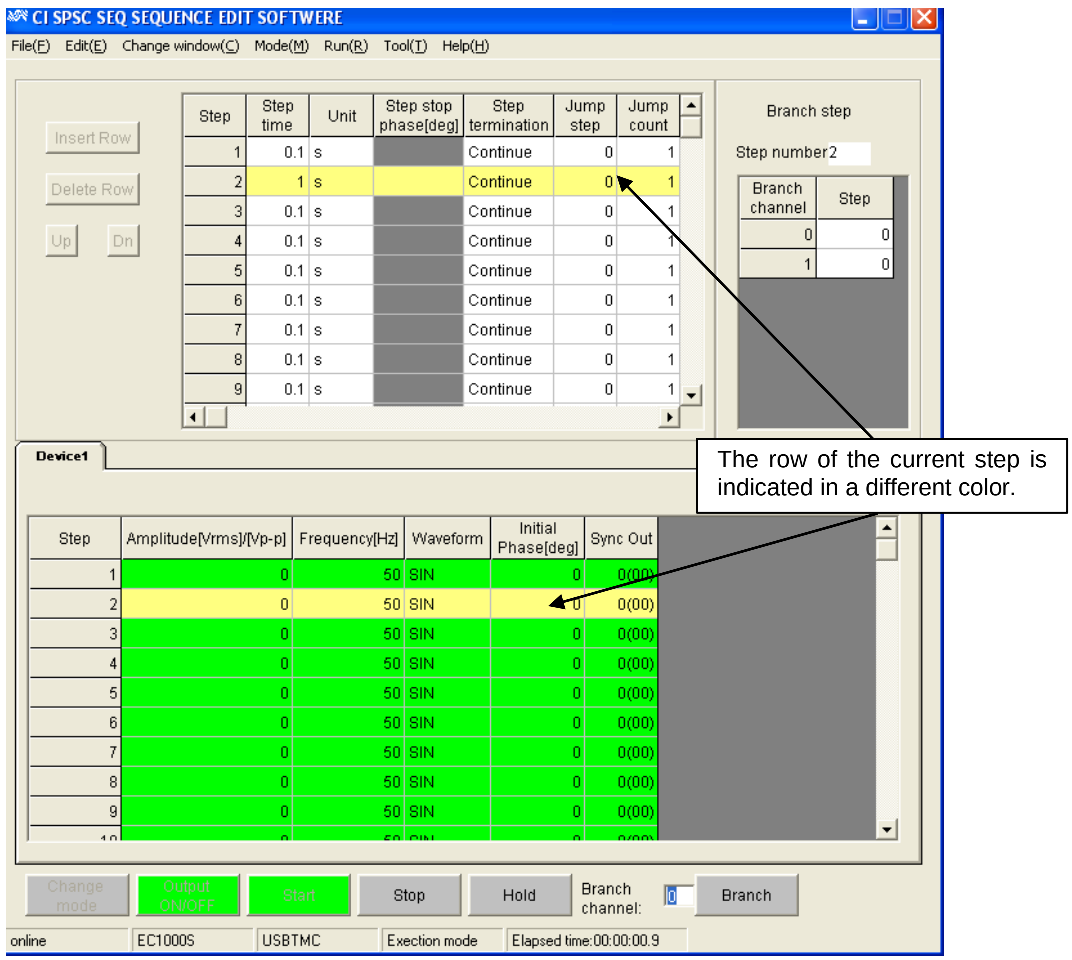


Figure 9-9 Monitoring the Sequence Execution

Once the sequence execution stops, the sequence execution monitor stops automatically, displaying the sequence execution stop message.

⚠ **Caution**

- The software monitors the device output condition when the sequence is being executed. If the device output goes off while the sequence is being executed, the software displays a message, stopping the sequence execution.

9.8 Message Display Area

This section details the message display area.

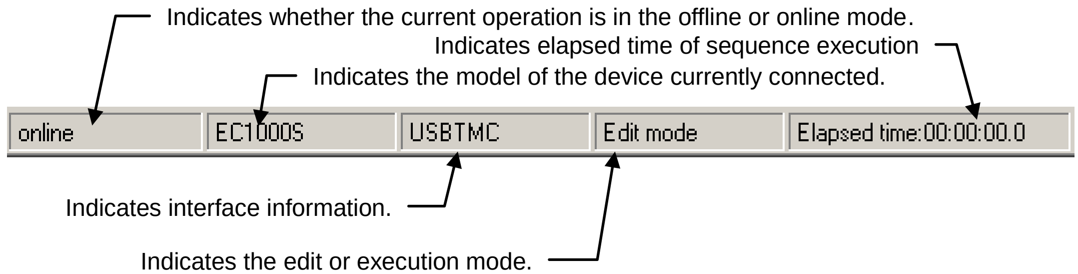


Figure 9-10 Message Display Area

When the sequence execution starts, the elapsed time of the sequence execution is incremented.

⚠ **Caution**

A slight error may occur in the elapsed time of the sequence. Interpret it as a reference value.

10. SEQUENCE VIEW WINDOW

10.1 Sequence View Window

When **[Change Window(C)] - [Sequence view window]** is selected, the sequence view window shown in "**Figure 10-1**" will be displayed. The created sequence data can be previewed in the **[Sequence View(V)]** window.

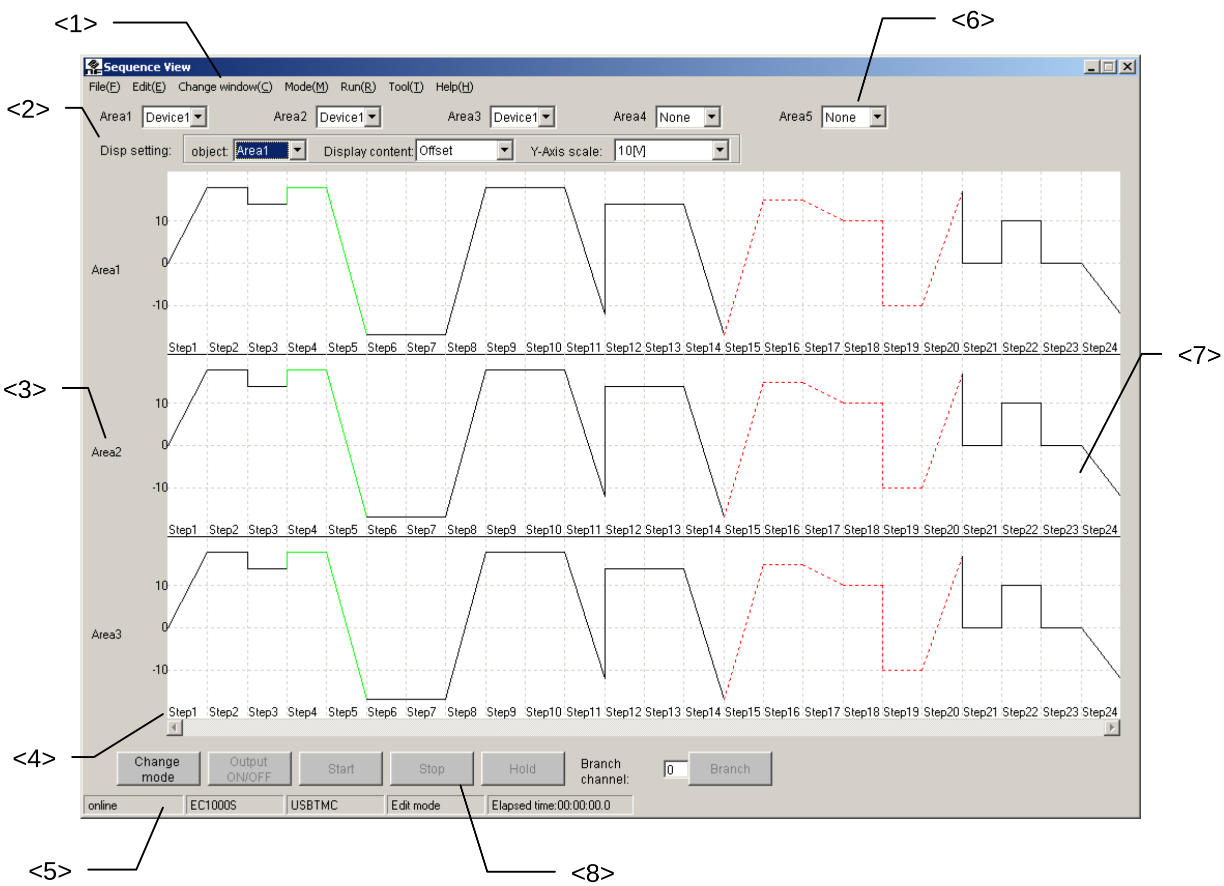


Figure 10-1 Sequence View Window

<1> Menu bar

Same as the menu bar in the Edit window.

☞ **See "9.2 Menu Organization".**

<2> Display settings

Sets the vertical axis scale and display parameters.

☞ **See "10.2.2 Display setting".**

<3> Area number

<4> Step number

<5> Message display area

Same as the Message display area in the Edit window.

☞ **See “9.8 Message Display Area”.**

<6> Selection of display area

Sequence graphs can be displayed in up to five areas.

☞ **See “10.2.1 Selecting display area”.**

<7> Sequence display area

☞ **See “10.2.3 Sequence Display Area”.**

<8> Sequence control buttons

Same as the sequence control buttons in the Edit window.

☞ **See “9.6 Sequence Control Buttons”.**

10.2 Sequence Preview

10.2.1 Selecting display area

Select from the combo box which connected device is to be displayed in the Sequence View window. Up to five sequence graphs can be displayed the sequence display area.

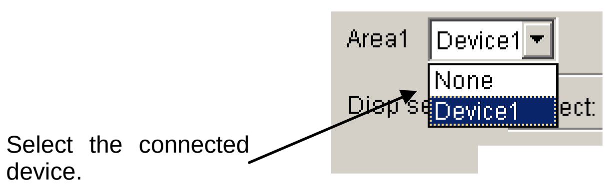


Figure 10-2 Select Display Area

If **[None]** is selected for the connected device, the sequence graph will not be displayed.

10.2.2 Display settings

For each display area, set the contents to be displayed and the vertical axis scale. The settings of these parameters will be accepted only in **[Edit mode]**.

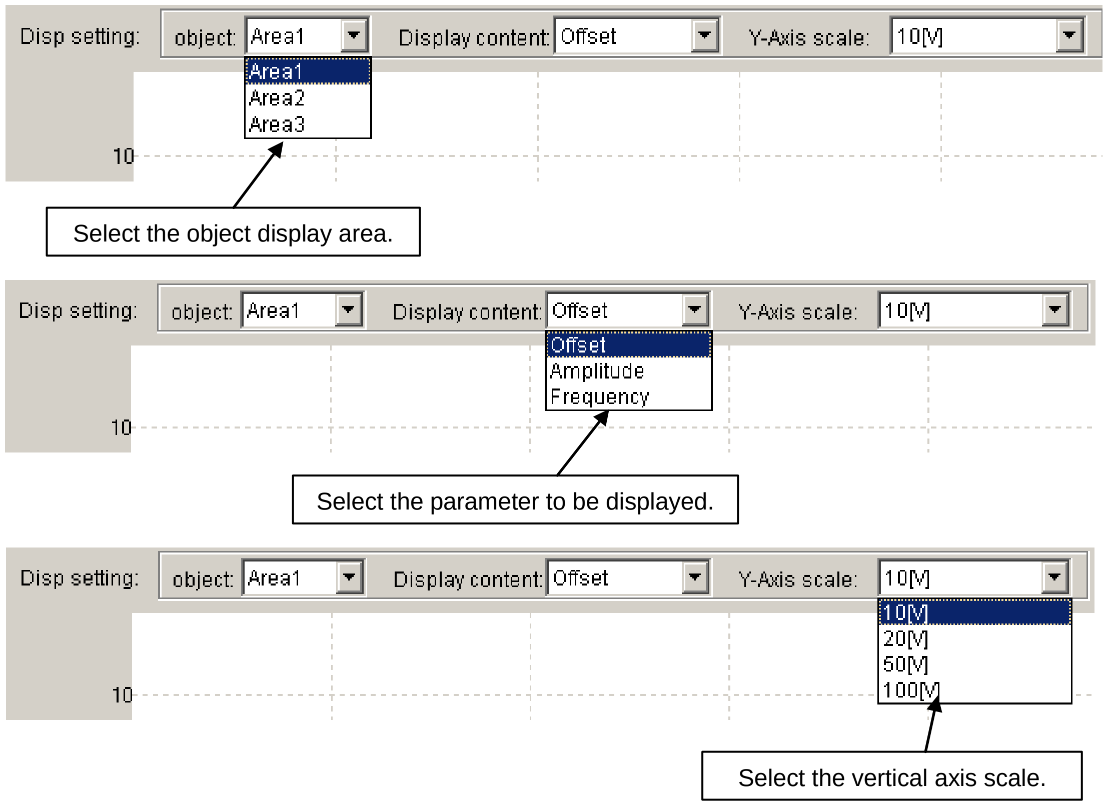


Figure 10-3 Selecting Display Area

10.2.3 Sequence Display Area

The sequence graph is displayed as shown in “Figure 10-4”.

Use the horizontal scroll bar to scroll the display to see the portions that are not in the sequence display area.

Any looping step is displayed only once by a green solid line. Any infinite looping step is displayed only once by a red dashed line.

If the number of steps is 24 or less, the sequence graph view will be enlarged according to the number of steps.

If the number of steps is 25 or more, the width of displayed steps is fixed.

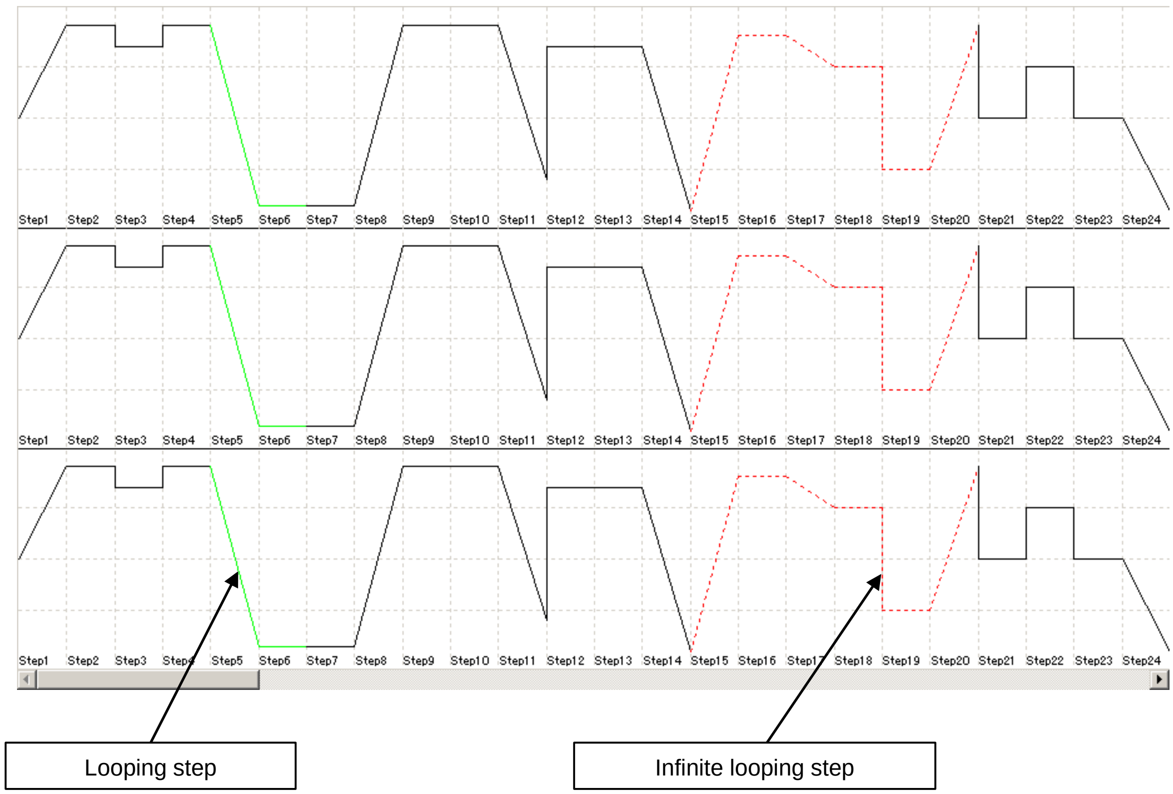


Figure 10-4 Sequence Display Area

10.3 Monitoring the Sequence Execution

When the Start button is clicked, sequence run monitoring starts as shown in “Figure 10-5”. While the sequence is being monitored, the window cannot be horizontally scrolled.

The current step area is displayed in a different color to indicate the progress of the sequence. The progress in each step is indicated by the sweep pointer.

When the sequence has started, the current step area moves from the left to the right in the window. If the current step is outside the sequence display area, the view is gradually scrolled in accordance with the progress.

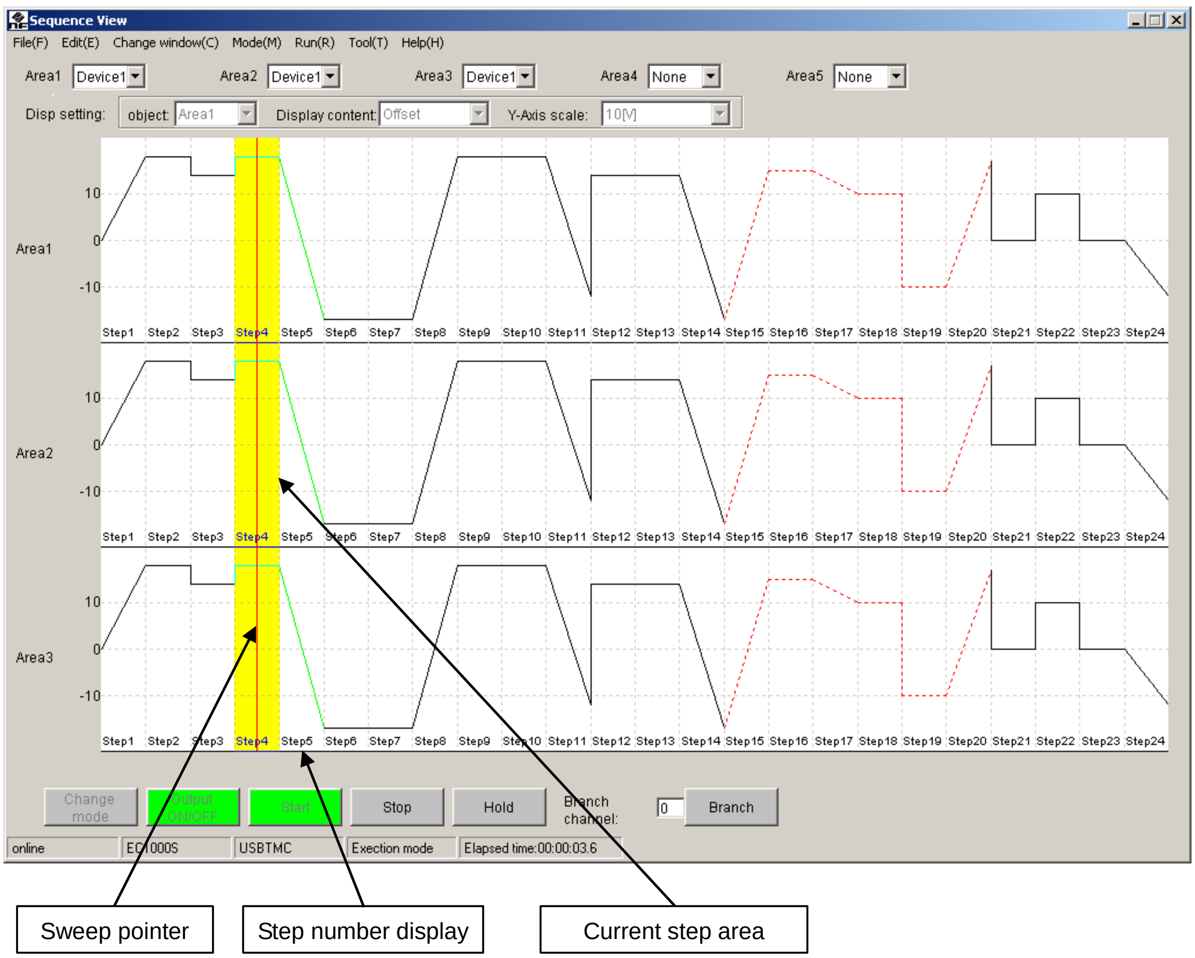


Figure 10-5 Display of the Sequence Progress

10.4 Sequence Control Buttons

The functions of the sequence control buttons are the same as those of the Edit window.

☞ **See “9.6 Sequence Control Buttons”.**

10.5 Message Display Area

The message display function is the same as that of the Edit window.

☞ **See “9.8 Message Display Area”.**

11. OTHER SCREEN OPERATIONS FOR SEQUENCE EDITING

11.1 Vertical Tiling

Select **[Change Window(C)] - [Tile Vertically(T)]** to tile the **[Edit window]** and **[Sequence view window]**, as shown in “Figure 11-1”.

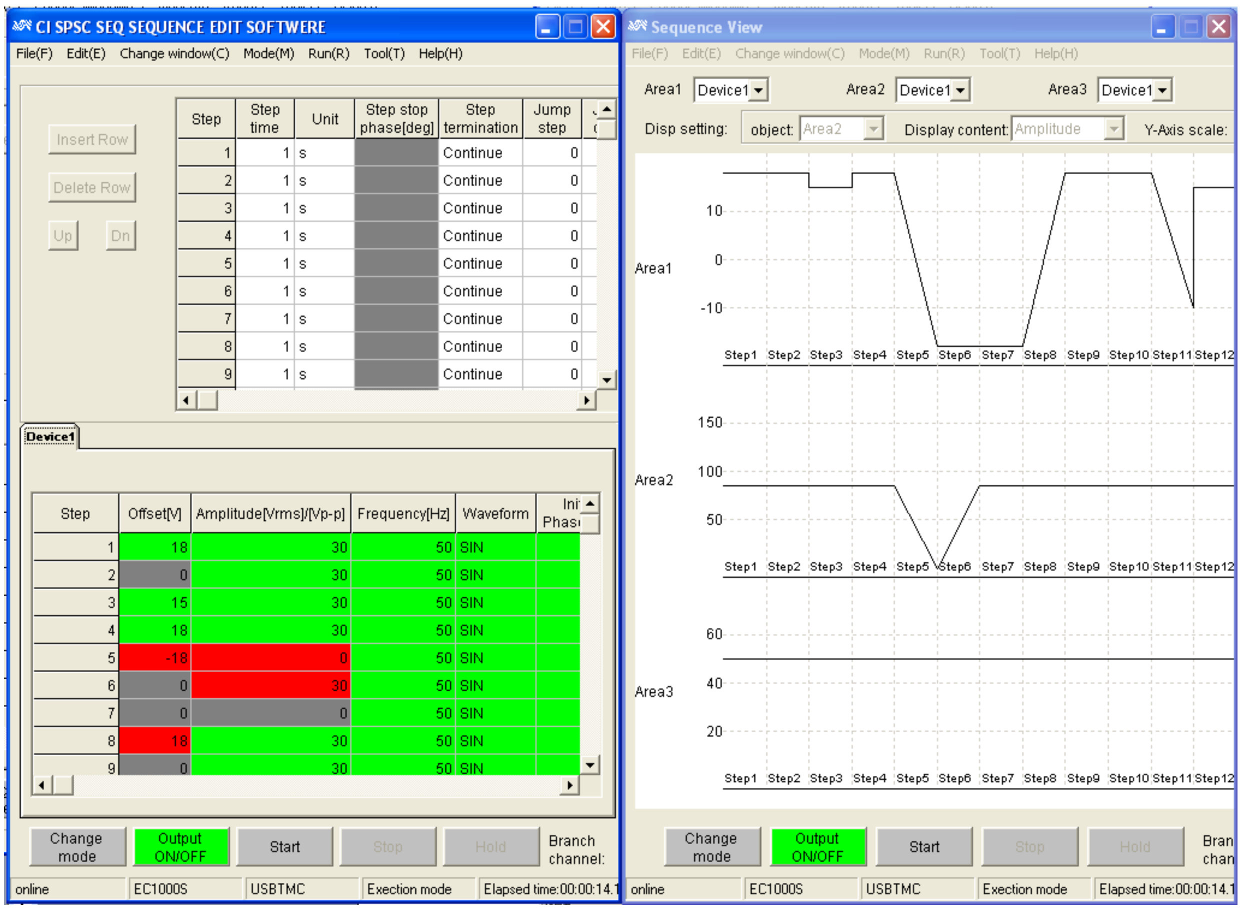


Figure 11-1 Vertically Tiling

The results of editing or modifying the sequence data in the Edit window on the left are automatically reflected in the Sequence view window on the right.

11.2 Offline Mode

This software checks whether a device is connected at every startup. If the software cannot find the connected device, a message appears to confirm that the software is to start up in the offline mode.

☞ **See "Figure 9-1".**

⚠ Caution

In the offline mode, the software operates only in the "edit mode". It is not impossible to change the mode to "execution mode".

11.3 Changes Between the Edit and Execution Modes

Edit mode and execution mode switched in two ways.

- Select **[Edit mode]** or **[Execution mode]** from the **[Mode]** menu.
- Click the Change mode button.

When switching from the Edit mode to the Execution mode, the software transfers the created sequence data to the device. The progress of transfer is displayed with the progress bar appearing in the center of the window.

⚠ Caution

Although the functions related to sequence execution can be executed in the execution mode, functions related to edit cannot be executed.

11.4 Transfer Arbitrary Wave Data

Select **[Tool(T)] - [Transfer arbitrary wave data(A)]** to display the **[Transfer arbitrary wave data]** dialog box, shown in “Figure 11-2”.

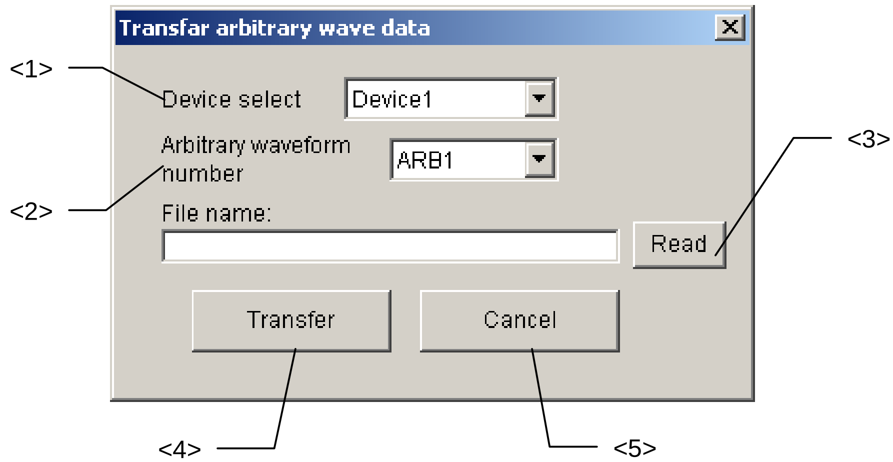


Figure 11-2 Transfar Arbitrary Wave Data Dialog Box

<1> Device

Specify the destination device in this field.

<2> Arbitrary waveform number

Specify the arbitrary waveform memory of the device into which the arbitrary waveform data is to be stored.

⚠ Caution

For arbitrary waveform numbers, see the **Programmable AC/DC Power Source EC1000S Instruction Manual.**

<3> Read

When the Read button is clicked, a **[Read]** dialog box like that in “**Figure 11-3**” appears. Specify a file to be read and open it.

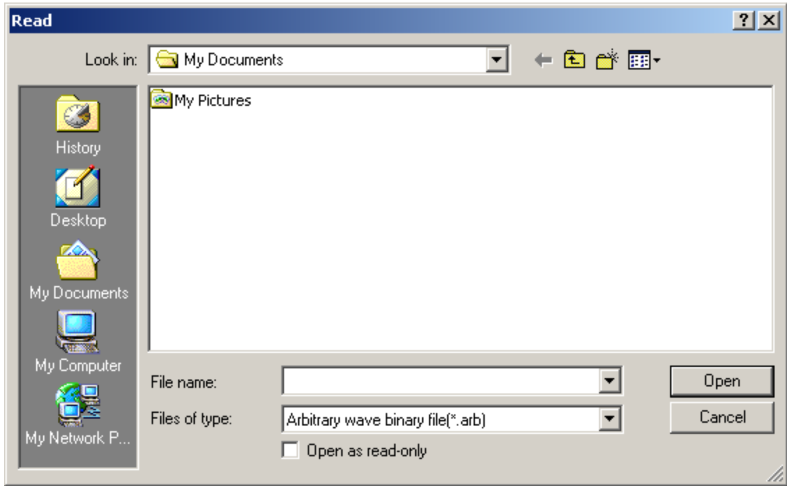


Figure 11-3 Read Dialog Box

<4> Transfer

When the Transfer button is clicked, the arbitrary wave data will be transferred to the device.

<5> Cancel

When the Cancel button is clicked, the operation is cancelled and the **[Transfar arbitrary wave data]** dialog box closes.

The following types of arbitrary waveform files can be read:

- Plain text file (extension: ".txt")

  Range of data: –16384 to 16383

  Contents of file: One data entry (no comma, left-justified) per line

  <Example> –16384
  1000
  2
  –10
  .
  .
  .
  4,096 lines are required.

- Text file that was output with "**SPSC ARB Arbitrary Waveform Editor"** (extension: ".txt")
- 2's complement binary files (extension: ".arb")

  Range of data: –16384 to 16383

  Contents of file: 4,096 words must be saved with big endian

  <Example> 0, 1000, 1500, 2000, … , -3000

  In the above example, the data is organized in the following order from the top of the file.

  0x00, 0x00, 0x03, 0xE8, 0x07, 0xd0, …, 0xF4, 0x48

- Binary file that was output with **SPSC ARB Arbitrary Waveform Editor**

(extension: ".wdb")

⚠ **Caution**

- The arbitrary waveform size of the Programmable AC/DC Power Source EC1000S is 4,096 words (1 word = 16 bits).
- The number of arbitrary waveform data units within an arbitrary waveform file must always be 4,096 words. If it is insufficient, an error message will appear.

11.5 Clear Arbitrary Waveform Memory

Selecting **[Tool(T)] - [Clear arbitrary waveform memory(C)]** displays the **[Clear arbitrary waveform memory]** dialog box, shown in "**Figure 11-4**". The arbitrary waveform memory for the specified device can be cleared by selecting the arbitrary waveform number and clicking the **[Clear]** button.

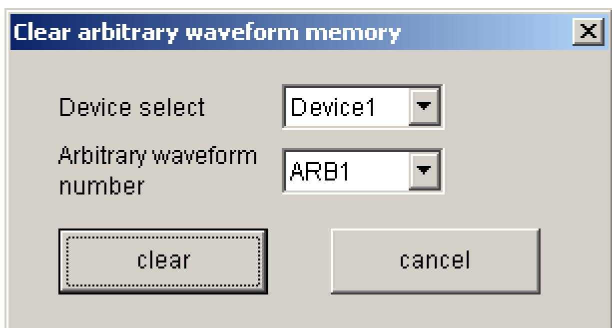


Figure 11-4 Clear Arbitrary Waveform Memory Dialog Box

⚠ **Caution**

The Clear arbitrary waveform memory function initializes the arbitrary waveform memory as follows, depending on the wave type:

ARB1 to ARB8: Sine wave
ARB9 to ARB12: Square wave
ARB13 to ARB16: Triangle wave

11.6 Mode Setting

Select **[Tool] - [Set mode]** to display the **[Set mode]** dialog box, shown in "**Figure 11-5**".

Click the OK button to make the set values reflected by the device.

If the sequence is in progress, it is not possible to change the "Set mode" setting.

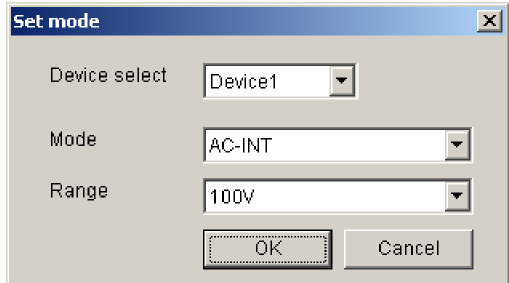


Figure 11-5 Set Mode Dialog Box

⚠ **Caution**

For details on setting 1, see the **Programmable AC/DC Power Source EC1000S Instruction Manual**.

11.7 System Settings

Select **[Tool(T)] - [Set System(I)]** to display the **[Set System(I)]** dialog box, shown in "**Figure 11-6**".

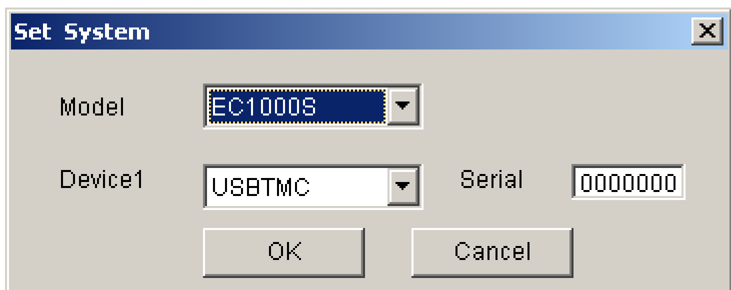


Figure 11-6 Set System Dialog Box

11.8 List of Initial Setting Values

11.8.1 Initial values of set parameters

Parameter Name	Initial Value	Remark
Step time	0.1	Unit: s
Step time unit	s	second
Step stop phase	Disabled	
Step termination	Stop	
Jump number	0	
Jump count	1	
DC voltage	0	Unit: V
DC voltage operation type	Constant	
AC voltage	0	Unit: Vp-p
AC voltage operation type	Constant	
Frequency	50	Unit: Hz
Frequency operation type	Constant	
Frequency unit	Hz	
Waveform	SIN	
Waveform operation type	Constant	
Step sync output	0 (00)	
Step sync output operation type	Constant	
Branch Step 0	0	
Branch Step 1	0	

11.8.2 List of other parameter initial values

Setting Item	Initial Value	Remark
Step	0	
Branch step l	0	
Display area 1	Device 1	
Display areas 2 to 5	None	
Object display settings	Area 1	
Display contents of display settings	AC voltage	
Vertical axis scale of display settings	10V	
Device selection	device1	
Arbitrary waveform number	SIN	
Mode Set	AC-INT	
Number of devices	1	
Device interface	USBTMC	
Serial number	0000000	

12. ERROR MESSAGES

12.1 Launcher Errors

The following table summarizes the error specifications of the SPSC Signal/Power Source Control Software.

Table 12-1 SPSC Error Messages

Message	Description
Can't start SPSC-RMT.	The specified software cannot be started because the software displayed on the message is operating. Exit the software displayed on the message and then start the specified software.
Can't start SPSC-ARB.	
Can't start SPSC-SEQ.	
Quit SPSC-RMT	The SPSC cannot be exited because the software displayed on the message is operating. Exit the software displayed on the message and then exit the SPSC.
Quit SPSC-ARB	
Quit SPSC-SEQ	

12.2 Remote Control Software Errors

The following table summarizes the error specifications of SPSC RMT Remote Control Software.

Table 12-2 SPSC RMT Error Messages

Message	Description
The device hasnot been connected.	The device set by the conditions cannot be communicated with at start or system setting modification.
Can't communicate with the device.	The device can no longer be communicated in the online status. The offline status is set.
Invalid file format.	The software is exited displaying the error message because the necessary file cannot be found in this software or is illegal at startup.
The sequence execution was stopped.	The sequence is stopped because the sequence of the device for which conditions are set is in progress at startup or when system setting is changed.
The device settings in the read device setting file contain an error.	An error occurred when the specified device setting file was read and set to the device. If an error persists even if the device setting file is read again by selecting **[Memory] - [Rest]**, do not use the device setting file.
Can't change the setting while logging.	A measurement value display that cannot be set during logging operation was set. To change the setting, stop logging once and change the setting. Reinstall the software.
Insufficient disk space.	Logging is stopped, displaying an error message due to insufficient disk space to which the logging data file is saved.
Writing error.	Logging is stopped, displaying an error message if an error occurred while data is written into the logging data file.
Invalid value for logging interval.	Set a logging condition, having a logging interval with a value between 1 and 60 seconds.
Designate the folder to save.	Specify a logging condition, saving the folder name.
Logging quitted for the maximum logging points.	Logging is stopped because 86,400 items have been logged since logging was started.

12.3 Arbitrary Wave Edit Software Error

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

Table 12-3 SPSC ARB Error Messages

Message	Description
Memory Allocation Failed.	Memory for OS operation could not be secured at startup.
No Spline point.	During waveform generation using interpolation, the interpolation was performed without any control points specified.
Cannot create two spline points on same X. Do you want continue?	Displayed when the leftmost and rightmost values of the Y axis are different when generating a waveform using interpolation.
File Write error.	An error occurred while a file was being saved in SPSC ARB. If this error persists, restart the SPSC ARB.
File Read error	An error occurred while a file was being read in the SPSC ARB. Do not use this file.
Clip Board Open error.	An error occurred during an inter-waveform operation executed for the clipboard. If this error persists, restart the SPSC ARB.
Clip Board Read error.	
Clip Board Write error.	
Clip Board error.	
Constant format error.	An arbitrary function expression for waveform generation contains an error. Modify the error cause according to the message.
Syntax error in equation.	
Lack of parenthesis.	
Unblance of parenthesis.	
Divided by 0.	
Compile error.	
Illegal Font Size.	Modify the specified font size in the printing dialog box.
No Listeners on the INTERFACE.	Communication with the device failed. Check the connection between the device and PC.

12.4 Sequence Edit Software Errors

The following table summarizes the error specifications of SPSC SEQ Sequence Edit Software.

Table 12-4 SPSC SEQ Error Messages

Message	Description
Initialization file doesn’t exit.	The SeqEditStd.ini file, required to start the software, was not found in the specified folder. Reinstall the software.
The sequence data file error.	The format in the sequence data file is illegal. Do not use this file.
Input value Error!	Enter the parameter within the range indicated with the error message. If a range is not shown, enter a valid numeric value.
The form of copy origin and copy destination is different.	Copying a cell or column to a different cell or column in the common parameters or sequence execution parameters setting area.
The communication error occurred.	While data was being transferred, power of Programmable AC/DC Power Source EC1000S was cut off or the USB cable was unplugged.
Can not access arbitrary waveform data. Please specify a correct file name.	Specify the correct arbitrary wave data file.
The arbitrary wave data size is insufficient.	The arbitrary wave data requires 4,096 words (8,192 bytes).

13. MAINTENANCE

②

13.1 Handling CD-ROM

Handle the CD-ROM carefully as described below.

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

13.2 Replacement of Damaged CD-ROM

If the SPSC Signal/Power Source Control Software CD-ROM is damaged, contact California Instruments or your local distributor.

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

13.3 Version Check

The SPSC Signal/Power Source Control Software version number is displayed on the CD-ROM.

The version can be displayed by selecting **[Help] - [Version]**. The following shows a version display dialog box example for **[SPSC SEQ]**.

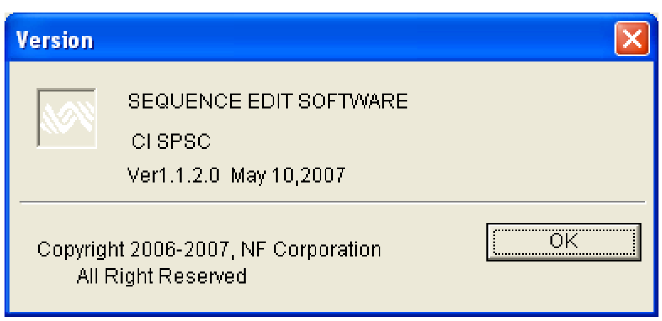


Figure 13-1 Version Dialog Box