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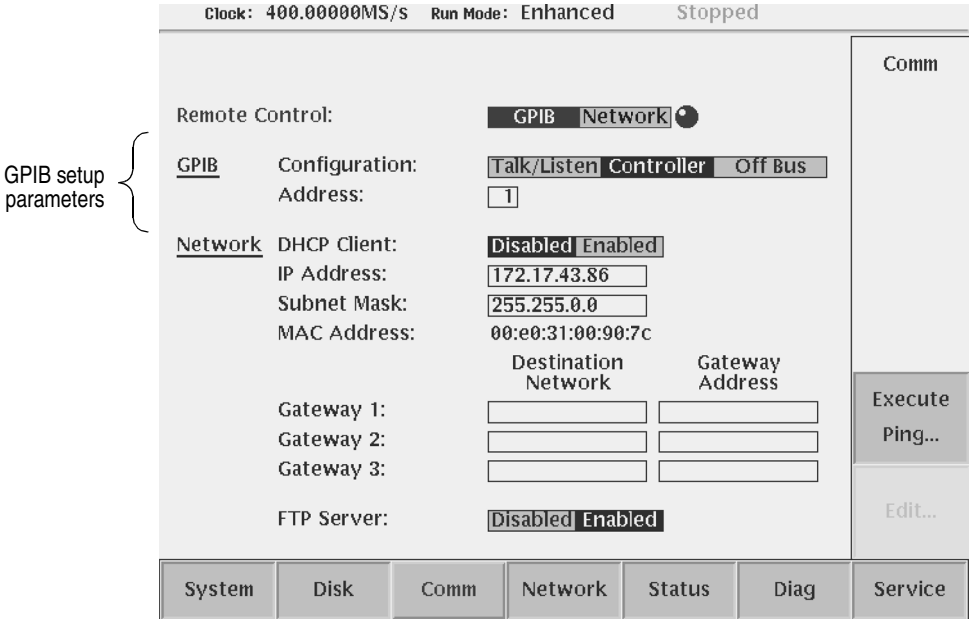


Figure 3-51: GPIB setup screen menu

2. Select **GPIB** for remote control.
   a. Select Remote control using ▲ and ▼ buttons.
   b. Select **GPIB**.
3. Set the GPIB bus connection parameter:
   a. Select the GPIB Configuration using ▲ and ▼ buttons.
   b. Select a configuration mode: **Talk/Listen**, **Controller**, or **Off Bus**.
4. Set the instrument GPIB address:
   a. Select the GPIB Address using ▲ and ▼ buttons.
   b. Set the GPIB address using the general purpose knob.

      Make sure that the value you enter is unique for this GPIB bus.

The changes take effect immediately.

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Ethernet Networking

The AWG710&AWG710B Arbitrary Waveform Generator can be connected to a network to access hard disk file systems in the remote computers that use Network File System (NFS) protocol. You can also log into the AWG710&AWG710B Arbitrary Waveform Generator from the remote computer to transfer files by using FTP link software.

You can set up to three remote computers with the AWG710&AWG710B Arbitrary Waveform Generator and mount their file systems at the same time. You select the remote files the same way that you select the internal hard disk or floppy disk.

This subsection describes the following network operations:

- Connecting to Ethernet
- Testing the network connection
- Network Parameter
- Mounting remote file systems
- Setting a FTP link

Refer to the AWG710&AWG710B *Programmer Manual* for more information on Ethernet networking.

Connecting to the Ethernet

You can connect the AWG710&AWG710B Arbitrary Waveform Generator to a 100/10 BASE–T Ethernet network. To mount a remote file system or to control the instrument from an external computer, you must set the following parameters in the instrument:

- IP address and Subnet Mask for the AWG710&AWG710B Arbitrary Waveform Generator

  or

  Automatically obtains IP address and other parameters with DHCP (Dynamic Host Configuration Protocol) client function.

- Up to three gateway addresses (if necessary)

Figure 3-52 shows the setup screen menu that you can use to set the network parameters to your AWG710&AWG710B Arbitrary Waveform Generator.

NOTE. *To connect the instrument to the Ethernet, you need to connect the cables before you power on the instrument.*

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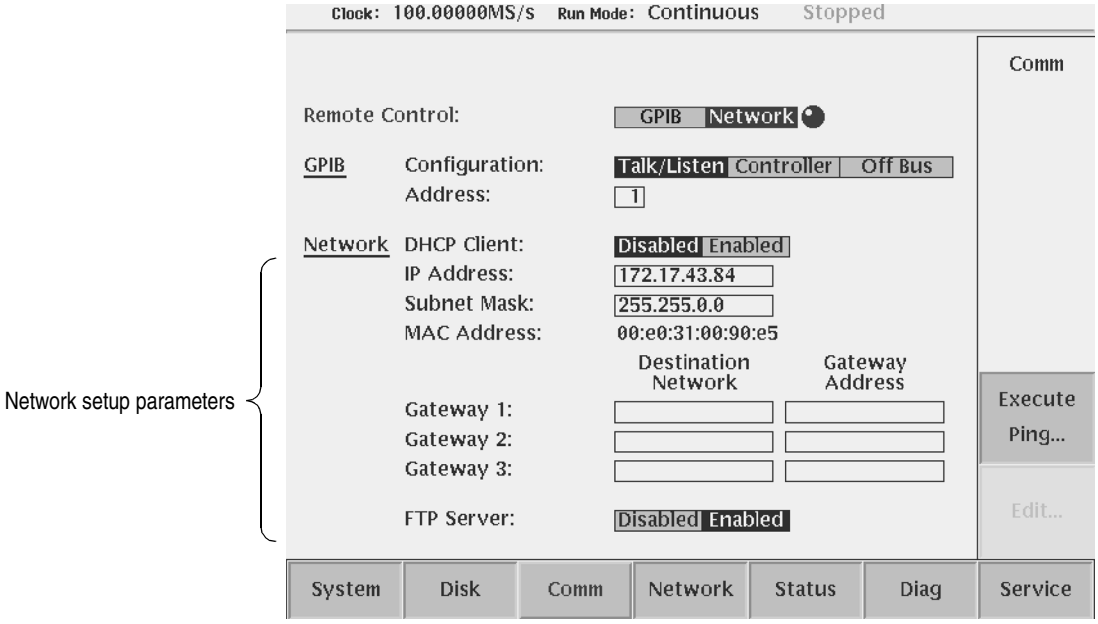


Figure 3-52: Network setup screen menu

To let the network recognize the AWG710&AWG710B Arbitrary Waveform Generator, set the IP address and Subnet Mask. If necessary, also set the Gateway address by the steps below:

1. Push **UTILITY** (front–panel)→**Comm** (bottom) to display the network setup screen menu.
2. Do the following steps to control the instrument through Ethernet.
   a. Select **Remote Control** using ▲ and ▼ buttons.
   b. Select **Network**.
3. Set an IP address of your AWG710&AWG710B Arbitrary Waveform Generator in the IP Address field. To set the IP address, there are two methods:

■ Set the parameters manually:

   a. Move the cursor to **DHCP client** field using ▲ and ▼ buttons, and select **Disabled** using the general purpose knob or ◀ ▶ buttons.
   b. Move the cursor to **IP Address** field using ▲ and ▼ buttons, and push **Edit...** side button.
   c. Set the IP address in the IP Address setup dialog box.
   d. If necessary, set a subnet mask in the Subnet Mask field.

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- Obtain an IP address automatically:

  e. Move the cursor to **DHCP client** field using ▲ and ▼ buttons, and select **Enabled** using the general purpose knob or ◀ ▶ buttons.

  f. AWG710&AWG710B Arbitrary Waveform Generator automatically sends a request for obtaining the address to DHCP server. The server sends back the address to the instrument. The address is displayed in the IP Address field.

4. If necessary, set a gateway address and destination network in the **Gateway Address** and **Destination Network** fields.

Set the Gateway address of a gateway when the remote computers are connecting to another network that is connected to the network through a gateway. You can set up to three gateways.

5. Set the FTP server to Disable or Enable in the FTP Server field.

Setting the FTP server to Enable allows you to enter into the hard disk system of the instrument from a remote computer.

The changes take effect immediately. If you are not familiar with the network setup, consult with your network administrator.

NOTE. *The port number is fixed to 4000. This port number must be assigned to the application software or the Ethernet driver on the external controller.*
The port number 4002 is used for communication between master and slave on the Synchronous operation mode. (only AWG710B)
The MAC Address is displayed on the network setup screen menu.

Testing the Network Connection

Complete the physical connection and settings. Verify that the AWG710&AWG710B Arbitrary Waveform Generator can recognize the network and the remote computers, and whether the network can recognize the AWG710&AWG710B Arbitrary Waveform Generator.

Do the following steps to use the ping command to verify that the instrument can communicate with the network:

1. Push **UTILITY** (front–panel)→**Network** (bottom) or **UTILITY** (front–panel)→**Comm** (bottom).

2. Push the **Execute Ping** side button to display a dialog box.

3. Enter the IP address of the remote computer in the dialog box.

4. Push the **OK** side button.

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The ping command sends a packet to the remote computer specified by the IP address. When the computer receives the packet, it sends the packet back to the sender (your AWG710&AWG710B Arbitrary Waveform Generator).

When the AWG710&AWG710B Arbitrary Waveform Generator can communicate with the remote computer through the network, the message as shown in Figure 3-53 is displayed. If it failed to establish the communication, the message box displaying an error message such as *No answer xx.xx.xx.xx* is displayed.

5. Repeat steps 2 and 3 for all the remote computers to which you desire to verify the connection through the network.



Figure 3-53: Message box to indicate the establishment of communication

Network Parameter

Select either **Comm** bottom button to display Communication screen or **Status** (bottom) → **Network** (side) buttons to display Status screen that show setting parameters for the network.



Figure 3-54: Network Status screen

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Optional Parameters

You can set the DHCP Lease Time, NFS Timeout and FTP server version. Do the following steps to set these parameters.

1. Push **UTILITY** (front–panel)→**Service** (bottom)→**Tweak AWG1** (pop–up)→**OK** (side).
2. Push **DHCP Lease Time** (side) and set the DHCP Lease time using the general purpose knob or the numeric keypads. The time range is from 30 to 86400 seconds (24 hours).
3. Push **NFS Timeout** (side) and set the NFS Timeout using the general purpose knob or the numeric keypads. The time range is from 25 to 300 seconds.
4. Push **FTP Version** (side) button to toggle between **Standard** and **Obsolete**. Usually, select Standard.

Mounting Remote File Systems

Figure 3-55 shows the screen menu in which you can set the parameters to mount a remote file system on the AWG710&AWG710B Arbitrary Waveform Generator, using the NFS protocol. Refer to the documentation about the NFS, for the details on the remote file system, the NFS protocol and/or how to set the NFS in the computers.

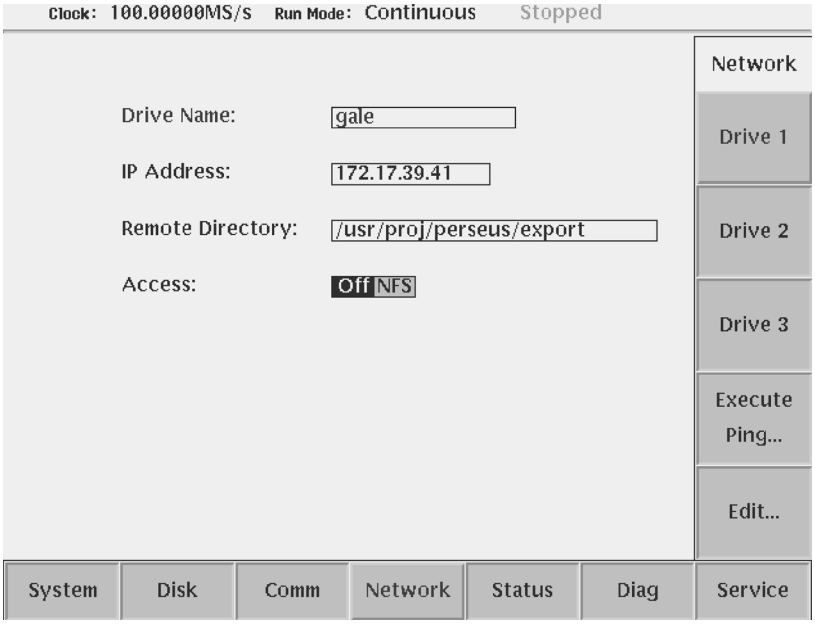


Figure 3-55: UTILITY screen mounting remote file system

Do the following steps to mount the remote file system:

1. Push **UTILITY** (front–panel)→**Network** (bottom).

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2. Push the **Drive1** side button for setting a remote file system as a drive 1.

   Do the following substeps to set the remote file system for the Drive 1:

NOTE. *You cannot select the Access field unless you set an IP address and remote directory.*

   a. Select the Drive Name: field using ▲ and ▼ buttons.

   b. Push the **Edit...** side button.

   The Drive Name dialog is displayed.

   c. Input a drive name using the Key pad and the General Purpose knob. (Push the Shift key to change the characters in the dialog box to upper case.)

   d. Push the **OK** side button to enter the drive name.

   The drive name set here is displayed as one of the drive selections. Figure 3-56 shows an example of the drive selections. In this case, the drive name of Drive 1 is changed with NET1 to UNIX02.

   Set the remote computers IP address in the IP Address field:

   e. Select the IP Address: field using ▲ and ▼ buttons.

   f. Push the **Edit...** side button.

   Network Drive Address dialog is displayed.

   g. Input a IP Address using the Key pad and the General Purpose knob.

   h. Push the **OK** side button to enter the IP Address.

   Set the remote computers directory in the Remote Directory field:

   i. Select the Remote Directory: field using ▲ and ▼ buttons.

   j. Push the **Edit...** side button.

   Network Drive Directory dialog is displayed.

   k. Input a remote computers directory name using the Key pad and the General Purpose knob. (A push on the Shift key changes characters in the dialog box to a capital letter.)

   l. Push the **OK** side button to enter the remote computers directory name.

   Specify a remote file system node in the Remote Directory field:

   m. Select the Access: field using ▲ and ▼ buttons.

   n. Select Off or NFS using ◀, ▶, or the General Purpose knob.

   You can connect or disconnect to/from the network logically while connecting physically. Select Off to disconnect, and NFS to connect.

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You can use all the file system existing under the node you specified here through the AWG710&AWG710B Arbitrary Waveform Generator.

3. Repeat substeps **a** through **n** to set the remote file systems for Drive 2 and Drive 3, if necessary.

The changes take effect immediately. You can use the remote file system defined in above procedures by selecting a storage media.

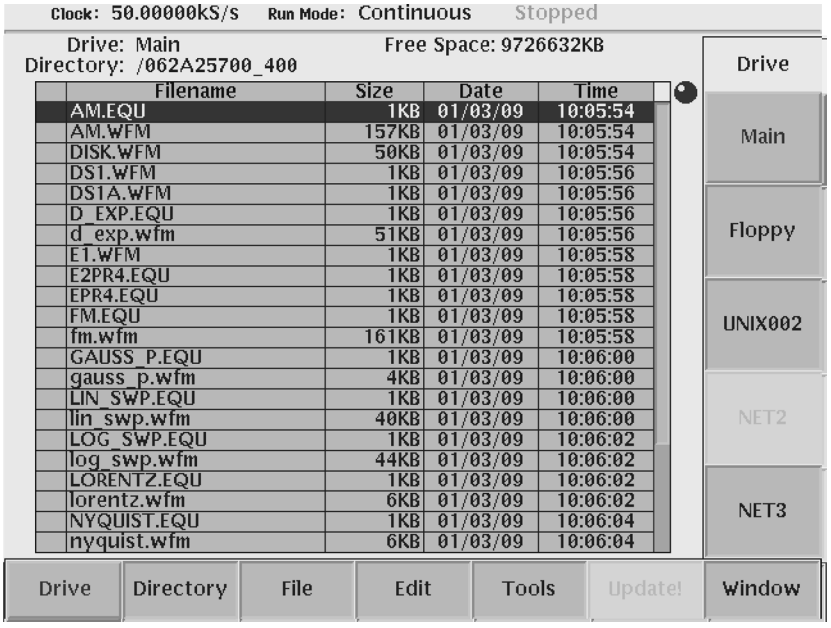


Figure 3-56: Drive selections in EDIT menu

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FTP Link

Set the FTP Server to enable you to enter into the hard disk or floppy disk file system of the AWG710&AWG710B Arbitrary Waveform Generator from a remote computer.

Type the following command on your computer keyboard:

ftp <IP address>

Press Return on the keyboard.

The AWG710&AWG710B Arbitrary Waveform Generator prompts you to enter a login name and password. Press the Return or Enter key on your keyboard. The message

'User log in'

and the prompt

'ftp>'

appears when you are successfully logged in.

At the prompt, you can use the commands as listed in Table 3-44. These are the only available FTP (File Transfer Protocol) commands for use with the instrument.

Table 3-44: Available FTP commands

Commands	Descriptions
ascii	Sets the file transfer mode to ascii.
binary	Sets the file transfer mode to binary. Use this mode when you transfer a file other than the text file.
bye	Terminate the ftp session and exit the ftp.
cd *xxxx*	Changes the current working directory on the instrument. Specify a directory at *xxxx*. To change the drive, specify "/*<drive–name>*/". For example, to move into the floppy disk, type the following: cd "/floppy/" Type "/main/" for the hard disk drive and "/NET1/" for remote file system NET1, and so on.
dir	Lists all the files in the current directory in the instrument.
get *xxxx [local–file]*	Receives the file *xxxx* in the instrument and stores it in the local file. The *xxxx* name is used if the local file is not specified
hash	Toggles the hash–sign on and off. The hash–sign is printed for each data block transferred when the hash–sign (#) is set to on.

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Table 3-44: Available FTP commands (cont.)

Commands	Descriptions
ls	Lists the all files in the current working directory in the instrument.
put *xxxx [remote–file]*	Transfers the file *xxxx* in your local computer and stores it in the instrument file. The same *xxxx* name is used for a instrument file if the remote file is not specified.
pwd	Print the path to the current directory in the instrument
quit	Terminates the ftp session and exits the ftp.

NOTE. *The ftp server in the* AWG710&AWG710B *Arbitrary Waveform Generator does not support mget commands, or meta characters. For example, when you use the* put *command with meta character as follows:*

put ABS.WFM *.*

*a file named *.* may be created in the internal disk of the* AWG710&AWG710B *Arbitrary Waveform Generator.*

*This *.* file is not displayed on the* AWG710&AWG710B *Arbitrary Waveform Generator file list. Access to a file created in this manner is not possible through the front panel. Use GPIB commands to access such files.*

In some FTP client software, you many not be able to use these commands.

Hardcopy

The image on the screen can be output to a file. Use a hardcopy file to make reports with a desktop publishing (DTP) application software running on PC, or output those files to a printer using a PC. You cannot connect a printer directly to the instrument.

Initiate hardcopy function by pushing the **HARDCOPY** button on the front–panel or entering the GPIB command. You can select either BMP, TIFF, BMP COLOR or TIFF COLOR for the file formats. Select the hard disk, floppy disk, or a remote computer file system for the file output destination. The file size is approximately 150 Kbytes for TIFF format and 300 Kbytes for other formats.

Hardcopy Settings

Specify the hardcopy format and the output destination you needed before running a hardcopy.

1. Push **UTILITY** (front–panel)→**System** (bottom) to display the hardcopy setup screen. See Figure 3-57.

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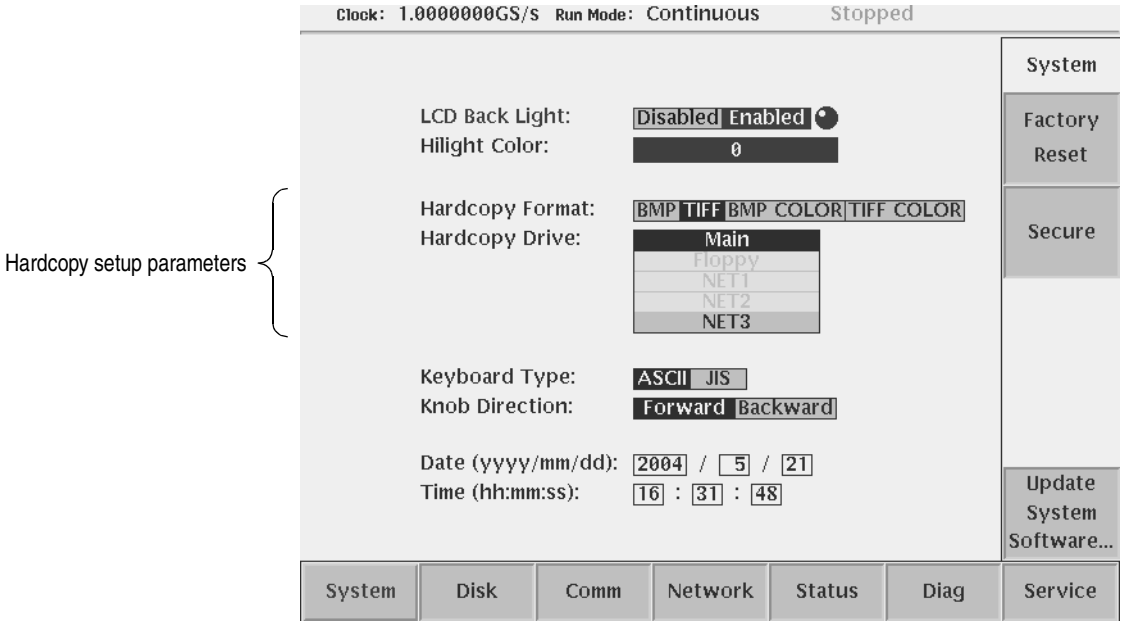


Figure 3-57: Hardcopy setup screen

2. Select **Hard Copy Format** using the ▲ or ▼ button.
3. Select either **BMP, TIFF, BMP COLOR,** or **TIFF COLOR** using the general purpose knob or the ◀ or ▶ button.
4. Select the **Hard Copy Drive** where the files are stored using the ▲ or ▼ button.
5. Select **Main**, **Floppy**, or **NETx** using the general purpose knob.

   The **NETx** refers to the remote computer file system that you defined. By default, they are **NET1**, **NET2** and **NET3**. For defining the remote file system, refer to page 3-166.

Running Hardcopy

When you push the **HARDCOPY** button on the front panel, the currently displayed image on the screen is output to an image file. The file format and output destination drive are as specified in the **UTILITY** menu. The destination directory is the current one.

Follow the steps below to make a hardcopy.

1. Display the view on the screen that you want hardcopied.
2. Push the **HARDCOPY** button on the front panel.

   A message box displaying the output destination and file name appear when the hardcopy function terminates. See Figure 3-58.

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Figure 3-58: Hardcopy complete message box

3. Push the **OK** side button.

Use the EDIT menu to rename a created file or move it to another directory.

Saving Hardcopy to a File

If you use the **HARDCOPY** button to produce a hardcopy file, a file name such as *TEK00000.BMP* is automatically assigned as the file name. The "TEK" substring is fixed. The "00000" substring indicates the counter value, which is reset to 0 each time you power on the instrument. Hereafter, it is incremented by 1 each time a hardcopy is produced. The extension is either 'BMP', 'TIF', 'BMP COLOR', or 'TIF COLOR', depending on the specified format. The output destination drive will be as specified in the UTILITY menu. The drive and path are the current drive and directory of the GPIB that are set when the **Hardcopy** command is received from the GPIB.

If you use the GPIB command to produce a hardcopy, you must specify the output filename using the filename only. Refer to the AWG710&AWG710B *Arbitrary Waveform Generator* Programmer Manual for more details.

Calibration and Diagnostics

The AWG710&AWG710B Arbitrary Waveform Generator can perform calibration and tests on the internal hardware. This function requires minimal time to perform, requires no additional equipment, and tests the internal hardware of the instrument. These tests can be used to quickly determine if the instrument is suitable for service.

The calibration and diagnostics can be performed in the screen that appears when you push **UTILITY** (front–panel)→**Diag** (bottom).

Calibration

The calibration updates the internal constants so that the instrument outputs waveforms within the specified accuracy. See Figure 3-60 for the calibration items and possible error codes.

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The calibration must be performed in the following cases:

- After a 20–minute warm up period
- Prior to high precision waveform output
- When the ambient temperature has changed more than +5 °C or less than -5 °C from the previous calibration

Refer to the calibration and diagnostic screen to see if calibration has recently been performed on the instrument. See Figure 3-60.

The calibration has completed when Done is displayed in the Calibration result field. No calibration has been performed if the **– – –** is displayed. The factory reset also causes the **– – –** to be displayed.

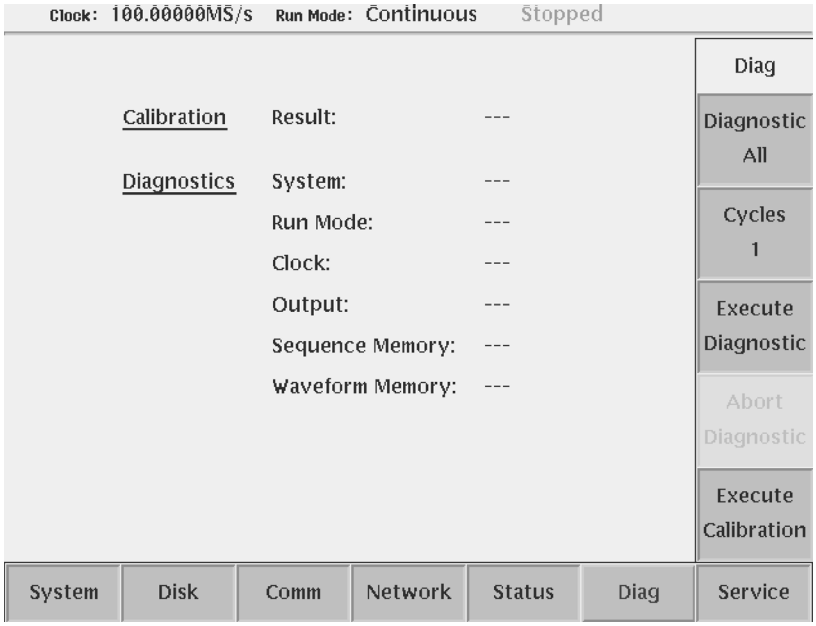


Figure 3-59: Calibration and diagnostic screen

NOTE. *The calibration data in the memory may be lost if the instrument is powered off while the calibrations are running.*

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Do the following steps to execute the calibration:

1. Push the **RUN** button to turn the output off if a waveform is being output.

   The RUN LED is off.

2. Push **UTILITY** (front–panel)→**Diag** (bottom)→**Execute Calibration** (side). The internal calibration routine runs immediately and requires up to 15 seconds to complete.

The status message box appears when calibration has been terminated. See Figure 3-60.

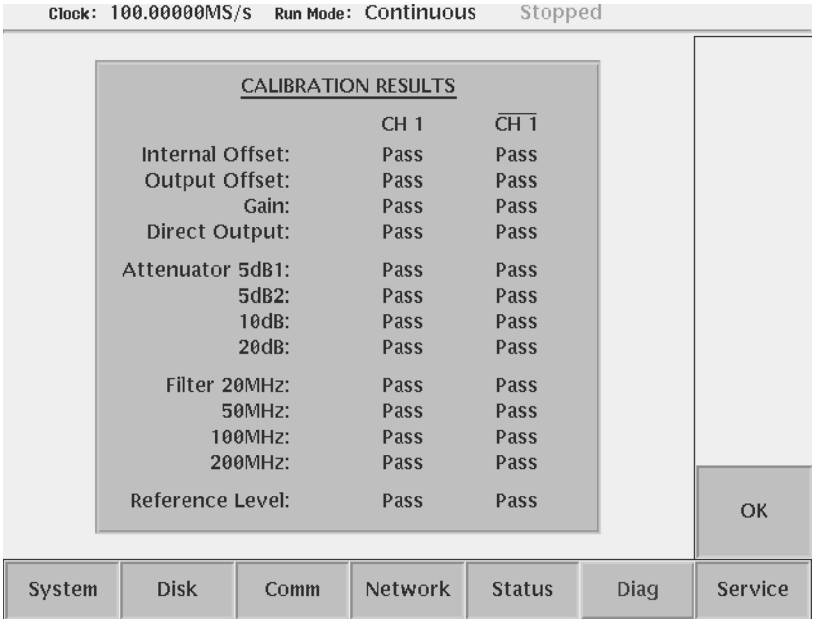


Figure 3-60: Status message box (except option02)

Pass is displayed in the message box if the calibration successfully terminates. **Fail** is displayed if calibration encounters a problem.

Push the **OK** side button or **CLEAR MENU** button to erase the status message box and return to the screen shown in Figure 3-59.

Power-on Diagnostics

At power on, a limited set of hardware tests for all the test categories are performed and the results are displayed on the screen. The instrument displays the following message when an error is detected:

Press any key to go to the SETUP menu screen.

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An error in the digital to analog converter (DAC) may be reported if you do not execute the system calibration at power–on.

See Table 3-45 for the test categories and error codes.

Manual Diagnostics

The manual diagnostics routines can execute a full set of hardware tests for all the test categories or only for the specified category except for the DAC. You can also specify a test cycle of 1 to infinite times.

NOTE. *When you execute the Waveform memory self test, it takes 1.5 minutes for standard type, 3 minutes for option 01.*

Do the following steps to execute the diagnostics:

1. Push the **RUN** button to turn the output off if a waveform is being output.

   The RUN LED turns off.

2. Push **UTILITY** (front–panel)→**Diag** (bottom).

   The screen shown in Figure 3-59 appears.

3. Push the **Diagnostic *xxxx*** side button and select a test category by using the general purpose knob.

   The *xxxx* represents currently selected test category. You can select a test category from All, System, Run Mode, Clock, Output, Seq Mem and Wave Mem. If you select All, the diagnostic routines of all categories are executed.

4. Push the **Cycle *n*** side button and select a test cycle by using the general purpose knob.

   The *n* represents a currently selected test cycle. You can select a test cycle from 1, 3, 10, 100 or Infinite. If you select Infinite, the diagnostic tests are repeated infinitely. Push the **Abort Diagnostic** side button to stop the execution.

5. Push the **Execute Diagnostic** side button to start the diagnostic tests.

The **– – –** is displayed at each test category on the screen either at the beginning or after the factory reset. The mark **– – –** is also displayed while the diagnostic test is executing. See Figure 3-60. When the diagnostic test terminates without error, Pass is displayed instead of the **– – –**. The test routine displays the error code and skips to the next test if an error is detected.

See Table 3-45 for the test categories and error codes.

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Table 3-45: Diagnostic categories and error codes

Categories	Error codes	Descriptions
Calibration	1101 to 1104	Internal offset calibration error
	1201 to 1204	Output offset calibration error
	1301 to 1304	Gain calibration error
	1401 to 1404	Gain difference calibration error
	1501 to 1504	Direct out calibration error
	1601 to 1604	Attenuator calibration error
	1611 to 1614	5dB attenuator 1 calibration error
	1621 to 1624	5dB attenuator 2 calibration error
	1631 to 1634	10dB attenuator calibration error
	1641 to 1644	20dB attenuator calibration error
	1701 to 1704	Filter calibration error
	1711 to 1714	20MHz filter calibration error
	1721 to 1724	50MHz filter calibration error
	1731 to 1734	100MHz filter calibration error
	1741 to 1744	200MHz filter calibration error
	1801 to 1804	Reference level error
System	2100	System test error
	2101	Real–time clock power test error
	2102	Configuration record, checksum status error
	2103	Incorrect configuration
	2104	Memory size test error
	2105	Fixed–disk drive initialization status error
	2106	Time status error
	2110 to 2116	Front–panel test error
	2700 to 2703	Calibration data test error
Run mode	3000	Run mode test error
	3100	Run mode control register 0 test error
	3101 to 3108	Run mode control register test error (reg0 to reg7)
	3200	Run mode control register 1 test error
	3201	Run mode control register 1 reg0
	3211	Run mode control register 1 reg10
Clock	4000	Clock test error
	4100	PLL lock/unlock test error

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Table 3-45: Diagnostic categories and error codes (cont.)

Categories	Error codes	Descriptions
Sequence memory	5000	Sequence memory test error
	5100	Data bus test error
	5101 to 5132	Data bus test error (bit 0 to bit 31)
	5200	Address bus test error
	5201 to 5216	Address bus test error (bit 0 to bit 15)
	5300	Chip cell test error
	5301 to 5302	Chip cell test error (chip 0 to chip 1)
	5350	Chip select test error
	5351 to 5352	Chip select test error (chip select 0 to chip select 1)
Waveform memory CH1	6000	Waveform memory test error
	6100	Data bus test error
	6101 to 6132	Data bus test error (bit 0 to bit 31)
	6150	Chip data bus test error
	6151 to 6186	Chip data bus test error (chip 0 to chip 31)
	6200	Address bus test error
	6201 to 6219	Address bus test error (bit 0 to bit 18)
	6300	Chip cell test error
	6301 to 6336	Chip cell test error (chip 0 to chip 35)
	6350	Chip select test error
	6351 to 6386	Chip select test error (chip select 0 to chip select 35)
Output	7000	Output test error
	7100	Internal offset device test error
	7101 to 7104	Internal offset device test error (CH1 to $\overline{\text{CH1}}$)
	7200	Output offset device test error
	7201 to 7204	Output offset device test error (CH1 to $\overline{\text{CH1}}$)
	7300	ARB gain test error
	7301 to 7304	ARB gain test error (CH1 to $\overline{\text{CH1}}$)
	7400	Direct gain test error
	7401 to 7404	Direct gain test error (CH1 to $\overline{\text{CH1}}$)
	7510	5dB attenuator 1 test error

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Table 3-45: Diagnostic categories and error codes (cont.)

Categories	Error codes	Descriptions
	7511 to 7514	5dB attenuator 1 test error (CH1 to $\overline{\text{CH1}}$)
	7520	5dB attenuator 2 test error
	7521 to 7524	5dB attenuator 2 test error (CH1 to $\overline{\text{CH1}}$)
	7530	10dB attenuator test error
	7531 to 7534	10dB attenuator test error (CH1 to $\overline{\text{CH1}}$)
	7540	20dB attenuator test error
	7541 to 7544	20dB attenuator test error (CH1 to $\overline{\text{CH1}}$)
	7610	20 MHz filter test error
	7611 to 7614	20 MHz filter test error (CH1 to CH1)
	7620	50 MHz filter test error
	7621 to 7624	50 MHz filter test error (CH1 to $\overline{\text{CH1}}$)
	7630	100 MHz filter test error
	7631 to 7634	100 MHz filter test error (CH1 to $\overline{\text{CH1}}$)
	7640	200 MHz filter test error
	7641 to 7644	200 MHz filter test error (CH1 to $\overline{\text{CH1}}$)
	7700 to 7704	Reference level test error
Waveform/Sequence	9111	Load error, memory full
	9112	Load error, invalid waveform length
	9113	Load error, waveform length too short
	9114	Load error, waveform length changed
	7700 to 7704	Reference level test error
Sequence	9121	Load error, missing file name in sequence
	9122	Load error, too many nesting levels
	9123	Load error, infinite loop in sub–sequence
	9124	Load error, infinite sub–sequence level
	9125	Load error, max sequence elements exceeded
	9126	Load error, invalid jump address
	9127	Load error, sequence memory full
	9128	Load error, infinite loop and Goto One not allowed
	9129	Load error, infinite loop and Goto <N> not allowed
Waveform	9151	Load warning, output disabled in some channels
Waveform/Sequence	9152	Output warning, output disabled

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Upgrading the System Software

The system software in the AWG710&AWG710B Arbitrary Waveform Generator can be updated by using the utility menu. The System software consists of both the user program and the operating system. The upgrades can be done independent of each other. Refer to page 3-158 for information regarding the current system software versions.

Preparation

Do the following prior to performing the system software upgrade procedure:

- Read the Instruction documents included in the upgrade kit carefully.
- Refer to the instruction documents included in the upgrade kit for more information.



CAUTION. *To avoid damage to the instrument, follow the instruction documentation included in the upgrade kit.*

Upgrade Procedure

Follow the steps below to upgrade system software:

1. Copy the system software in the upgrade kit to the AWG710&AWG710B Arbitrary Waveform Generator internal disk.
2. Push **UTILITY** (front–panel) → **System** (bottom) → **Update System Software...** (side) → **Update Program...** or **Update OS...** (side).
3. Before executing the update, a caution dialog appears. Push the **OK** (side) button to continue, or the **Cancel** (side) button to abort.

   The Select File dialog box appears.
4. Select the file for upgrade that was copied in step 1, then press the **OK** (side) button.

   The file confirmation dialog box appears.
5. Press the **OK** (side) button.

   The AWG710&AWG710B Arbitrary Waveform Generator checks the selected file properties. The “Illegal file format” message appears if you select an invalid file. The AWG710&AWG710B Arbitrary Waveform Generator updates the system software.
6. After the updating procedure has completed, power off, then power on the instrument. The AWG710&AWG710B Arbitrary Waveform Generator starts up with updated system software.

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Capturing Waveforms

This section explains how to transfer waveforms from the instruments to the AWG710&AWG710B Arbitrary Waveform Generator using the GPIB interfaces.

The AWG710&AWG710B Arbitrary Waveform Generator captures the waveform data acquired in oscilloscopes and/or generated in generators over the GPIB interface without control by an external controller. The waveforms captured are automatically converted to waveforms that the AWG710&AWG710B Arbitrary Waveform Generator can handle.

When you use this function, set the AWG710&AWG710B Arbitrary Waveform Generator GPIB configuration to controller.

Possible Instruments

The Waveform Generator captures waveforms from following instruments:

- Tektronix TDS–Series oscilloscopes
- LeCroy digital oscilloscopes

Basic Concept on Communication for Capturing

Waveform data is transferred over the GPIB network. The AWG710&AWG710B Arbitrary Waveform Generator must be the controller and the other instrument(s) must be in the Talk/Listen mode. All instruments including the AWG710&AWG710B Arbitrary Waveform Generator must have a unique GPIB address.

When you execute this function, the AWG710&AWG710B Arbitrary Waveform Generator starts addressing the instruments that are connecting to the same GPIB network from the lower to the higher GPIB address. When an addressed instrument responds, the AWG710&AWG710B Arbitrary Waveform Generator stops addressing and starts the negotiation for waveform data transfer.

The AWG710&AWG710B Arbitrary Waveform Generator communicates with the first instrument that responds (possibly the one that has the lowest GPIB address in the same network) and the type that you specified.

You must set the GPIB address and Talk/Listen mode, but you do not need the other settings in the source instrument. The AWG710&AWG710B Arbitrary Waveform Generator performs all settings to the source instrument necessary for waveform transfer during negotiation.

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Procedures for Capturing Waveforms

Do the following steps to capture a waveform:

1. Set the GPIB parameters in the AWG710&AWG710B Arbitrary Waveform Generator.

   The AWG710&AWG710B Arbitrary Waveform Generator must be set to the controller. Refer to *Connecting to a GPIB Network* on page 3-160 for setting the GPIB parameters.

2. Push **UTILITY** (front–panel)→**Comm** (bottom)
3. Select Remote control field using ▲ and ▼ buttons. Select **GPIB**.
4. Select the GPIB Configuration field using ▲ and ▼ buttons. Select **Controller**.
5. Set the AWG710&AWG710B GPIB address.
6. Push **EDIT** (front–panel)→**Tools** (bottom)→**Capture Waveform** (side).

   The dialog box listing the instruments appears as shown in Figure 3-61.

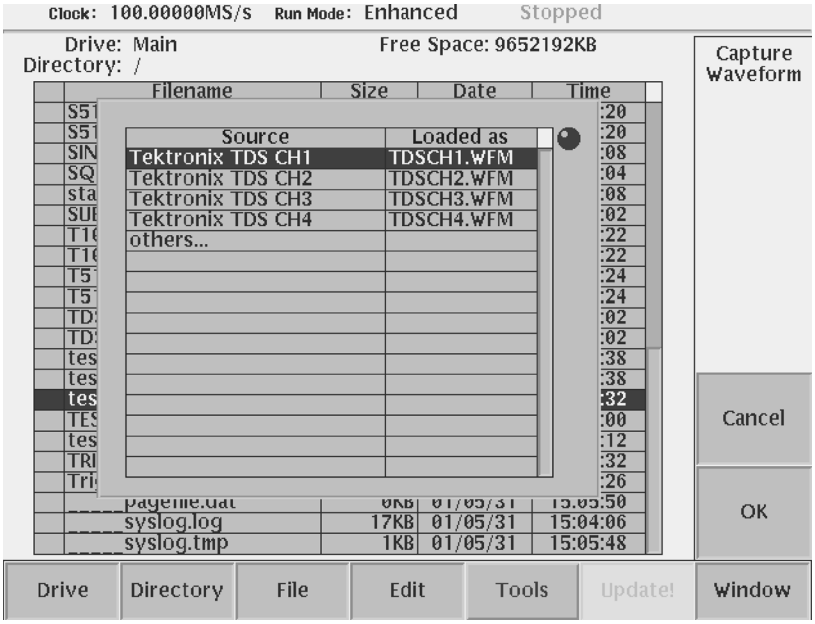


Figure 3-61: Source instrument selection dialog box

   a. If necessary, select **Others...** to open the other source instrument list.

      The dialog box listing the instruments appears as shown in Figure 3-62.

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b. Select a source instrument from the list.

c. Push the **OK** side button.

The AWG710&AWG710B Arbitrary Waveform Generator starts transferring the waveform from the selected source instrument. The file transferred to the AWG710&AWG710B Arbitrary Waveform Generator is automatically converted and saved in the file specified in the column of the line you selected. If needed, change the file name and perform another waveform data transfer.

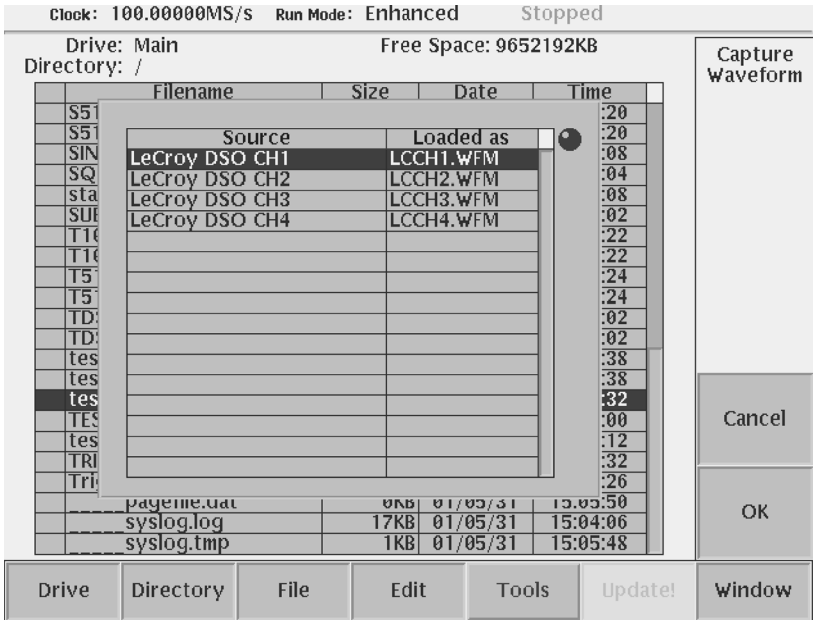


Figure 3-62: Source instrument selection under Others...

NOTE. *The* AWG710&AWG710B *Arbitrary Waveform Generator is unable to transfer waveforms during some oscilloscope acquisition modes such as Fast Acquisition, for example. When this happens, stop the oscilloscope acquisition and then perform the transfer to the* AWG710&AWG710B. *Contact the Tektronix Technical support for more information.*

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About Transferred Files

When you capture a waveform from a selected instrument, the corresponding waveform file is created in the current directory of the current drive. At the same time, the setup file is also created to save the setup information such as amplitude and offset.

Use the setup file to output the waveform file with the same settings as those captured in the instrument.

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Waveform Programming Language

This section describes the Waveform Programming Language (WPL) syntax, rules, and command descriptions. There are also a number of programming examples at the end of this section.

Command Syntax

This manual uses the Backus–Naur Form (BNF) notation, shown in Table 3-46, to describe commands.

Table 3-46: BNF symbols and meanings

Symbol	Meaning
< >	Defined element
[ ]	Optional; can be omitted
...	Previous element(s) may be repeated

General Syntax Rules

Following are the general syntax rules for writing an equation file:

- All spaces, line feeds, and tab codes are ignored unless in a string.
- The concept of a line does not exist.
- All data from a single quote (') to the end of a line is regarded as a comment.
- Alphabetical characters are case–insensitive unless in a string.
- The concept of cursor does not exist. You always work with the whole waveform.
- File attribute functions are unavailable in a waveform expression.
- The maximum length of a string is 256 characters, including spaces. Even if two or more strings are linked by colons (:) in a string expression, the whole length of the linked strings must not exceed 256 characters or an error will occur.
- The total length of strings in the whole equation program can be up to 1,000. (The length is the sum of the number of characters of the string(s) plus a character used as the internal terminal code.)

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User–Defined Variables

All user–defined variable names must satisfy the following requirements:

- The first character must be an alphabetical character.
- The rest of the name must consist of an alphabetical character(s), digit(s), and/or an underscore(s) (_).
- The maximum number of characters is 16. All characters in excess of 16 are ignored. Variables that have the same first 16 characters will be regarded as identical.
- Alphabetical characters are case–insensitive. For example, FooBar and foobar are handled as the same variable name.
- You can use user–defined variables in the program without first declaring them.
- User–defined variables are 64–bit floating–point decimal numbers.
- A maximum of 100 variables may be included in a program; this includes the reserved variables, such as clock.
- There are no string variables; all variables require a numeric value.
- Initial variable values are undefined.

The following are unavailable for user–defined variables.

- Reserved word variable names
- Constant names
- Function names
- Keywords (for example, if and marker1)

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Waveform Files

Some commands accept a waveform file name enclosed in double quotes. For example: `"sinewave.wfm"`. Observe the following rules when using waveform expressions in equations:

- A quoted string can include any character defined in the 7–bit ASCII character set.
- A numeric value can be embedded in a string in the following format:

  “AA”:i:“.WFM”

  If the value of i equals 10, the string “AA10.WFM” will result. Before conversion into the string, the value is rounded to the nearest integer.
- One waveform expression can include a maximum of 10 input files. If the same file name appears more than once in a single waveform expression, that file is considered as one file. An exception to this is that “A.WFM” and “A.WFM”.marker1 are two different files.
- Signal names, as well as variables, are permitted in a waveform expression. Waveform expressions enable you to specify calculation between waveforms in a similar manner as ordinary expressions. For example, if you code the following:

  “A.WFM” = sin(2*pi*scale) + “B.WFM”

  A.WFM is produced as the sum of the sinewave equation and B.WFM waveforms.

Waveform Expression

The output name, placed to the left of an ‘=’, and the name used in the expression to the right of an ‘=’ is a <signal–name>. The marker data may be specified as follows in addition to the name of an ordinary waveform file:

“A.WFM”.marker2 = “A.WFM” > “B.WFM” > “B.WFM”

In this example, 1 is set if the A.WFM value as the A.WFM marker 2 value is larger than the B.WFM value; 0 is set otherwise. (This is the same as for the compare function of the editor.) The A.WFM analog data is unchanged.

“B.WFM”.marker1 = “A.WFM”.marker1 + “A.WFM”.marker2

In this example, B.WFM’s marker1 is set if either marker 1 or 2 of A.WFM is 1.

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In a waveform expression, the data length of the file created and the clock information are determined as follows.

If <output–signal–name> is a marker:

If the output file does not already exist, an error will occur. Attributes such as the data length (output file size) and clock information are unchanged. The analog data section does not change. Neither the size or the close variable value is used. If the waveform expression includes a <signal–name>, then a file shorter than the output file would cause an error. If the input file is longer in this case, the data around the tail will not be used.

If <output–signal–name> is analog data:

A new file is always created without using the output file. Since the same file name may be specified for the input, the new file is tentatively created under another file name; then renamed.

All output file marker values will be 0. The output file data length and clock information will be as indicated on the screen.

If the waveform expression includes one or more <signal–name>s:

The output waveform length will equal to that of the shortest waveforms included in the <waveform–expression>. The clock information will match the one appearing first (that is, the one coded at the leftmost) out of those used in the waveform expression.

If the waveform expression includes no <signal–name>:

The output waveform length depends on the size variable value. The clock value depends on the clock variable value.

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Command Descriptions

The WPL commands are listed in alphabetical order. Mathematical functions and operators are described under the headings *Math Functions* on page 3-200 and *Math Operators* on page 3-202.

Bpf( )

The bpf() statement creates a new waveform file by passing the specified waveform file through a band–pass filter.

Group Waveform

Syntax

```
"output_filename" = bpf("filename1", cutoff_freq_lo,
                                cutoff_freq_hi, taps, atten)
```

Arguments

`"output_filename"` is the complete file name (file name and extension) to contain the filtered waveform data. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename1"` is the complete (file name and extension) name of the source file for the band–pass filter operation. The file must be on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`cutoff_freq_lo` is the band–pass filter low–frequency cutoff value. You can enter the value as a real or scientific notation number or as an expression that resolves to a valid number.

`cutoff_freq_hi` is the band–pass filter high–frequency cutoff value. You can enter the value as a real or scientific notation number or as an expression that resolves to a valid number.

`taps` is the number of delay elements that composes the digital filter. The range of taps is 3 to 101. You must enter the integer value as an odd number.

`atten` is the inhibit zone attenuation factor, in dB. The range of attenuation is 21 dB to 100 dB. You can enter the integer value.

Example

```
"filtered.wfm" = bpf("sine.wfm", 3.0e6, 5.0e6, 101, 35)
```


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Brf( )

The brf() statement creates a new waveform file by passing the specified waveform file through a band–rejection filter.

Group Waveform

Syntax

```
"output_filename" = brf("filename1", cutoff_freq_lo,
                                cutoff_freq_hi, taps, atten)
```

Arguments

`"output_filename"` is the complete file name (file name and extension) to contain the filtered waveform data. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename1"` is the complete (file name and extension) name of the source file for the band–pass filter operation. The file must be on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`cutoff_freq_lo` is the band–reject filter low–frequency cutoff value. You can enter the value as a real or scientific notation number or as an expression that resolves to a valid number.

`cutoff_freq_hi` is the band–reject filter high–frequency cutoff value. You can enter the value as a real or scientific notation number or as an expression that resolves to a valid number.

`taps` is the number of delay elements that composes the digital filter. The range of taps is 3 to 101. You must enter the integer value as an odd number.

`atten` is the inhibit zone attenuation factor, in dB. The range of attenuation is 21 dB to 100 dB. You can enter the integer value.

Example

```
"filtered.wfm" = brf("sine.wfm", 3.0e6, 5.0e6, 101, 45)
```


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Code( )

The code() statement executes code conversion.

Group Waveform

Syntax `"output_filename" = code("filename1", "codeÐconversionÐtable")`

Arguments `"output_filename"` is the complete file name (file name and extension) to contain the code–converted waveform data. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename1"` is the complete (file name and extension) name of the source file for the code conversion operation. The file is 0 1 pattern data. If the file is an analog waveform file, this function reads as 1 if the data value is equal to or larger than 0.5, and 0 if the value is less than 0.5. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"codeÐconversionÐtable"` is the text file containing a code conversion table in text form. You can use the files that are saved with the Code Conversion Table in the waveform or pattern editor. You can also create those text file each line of which composes of the following five fields delimited by comma (,):

PAST source, Current source, Next source, Past output, Output code

Refer to *The Tools Menu* on page 3-87 for the meaning of each field, and to the *Code Conversion Table Text Files* on page F-12. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

Example `"C1.WFM" = code("C0.WFM", "nrz.txt")`

Conv( )

The conv() statement executes convolution between the waveform data of two specified files. All marker values in the output file are set to 0.

Group Waveform

Syntax `"output_filename" = conv("filename1", "filename2")`

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Arguments `"output_filename"` is the complete file name (file name and extension) to contain the resultant convolution waveform. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename1"` and `"filename2"` are the complete (file name and extension) names of the files on which you are performing the convolution. Both files must be on the active drive. The argument can include a relative or absolute path name. Enclose each file name within double quotation marks.

Example

```
"newsine.wfm" = conv("sine.wfm", "sine2x.wfm")
```

Copy( )

The copy() statement copies the specified file name to a new file name and/or location on the current drive.

Group Waveform

Syntax

```
copy("source_file", "target_file")
```

Arguments `"source_file"` is the complete file name (path, file name and extension) to the file that you want to copy. The file must be located on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"target_file"` is the complete file name (path, file name and extension) to the location to which you are copying the source file. The target file must be located on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

Example

```
copy("sine.wfm", "/test_dir/sine2.wfm")
```

Corr( )

The corr() statement executes correlation between the waveform data of two specified files. All marker values in the output file are set to 0. There are no restrictions on the data lengths of the two waveforms. For markers, the value of the first point is 1, and those of all the others are 0. Refer to *Correlation* on page F-5 for more information.

Group Waveform

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Syntax `"output_filename" = corr("filename1", "filename2")`

Arguments `"output_filename"` is the complete file name (file name and extension) to contain the resultant correlation waveform. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename1"` and `"filename2"` are the complete (file name and extension) names of the files on which you are performing the correlation. Both files must be on the active drive. The argument can include a relative or absolute path name. Enclose each file name within double quotation marks.

Example `"corrwave.wfm" = corr("sine.wfm", "sine2x.wfm")`

Data( )

The data() statement writes the defined data points to the specified file. The number of <expression>s specified must equal the number of points. All marker values will be 0. At least one <expression> must be included.

Group Waveform

Syntax `"output_filename" = data(data_defn, data_defn, ...)`

Arguments `"output_filename"` is the complete file name (file name and extension) to contain the expanded waveform and marker data. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`data_defn` is a value that defines the data point value. The first data point value starts at point 0. You must include at least one data definition expression. Separate each definition with a comma.

NOTE. *This command lets you create a waveform file that does not meet the instrument waveform minimum data requirement (minimum of 960 points, evenly divisible by four). If you create such a file, open it in a waveform editor, and then attempt to save it, the instrument displays a dialog box asking you to correct the problem. If you attempt to load the waveform in the Setup screen, the instrument displays an error message stating that the file does not have enough data points.*

Example `"foo.wfm" = data(1, 0, .2, .4, .5)`

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Delete( )

The delete() statement deletes the specified file name from the current drive.

Group Waveform

Syntax `delete("filename")\`

Arguments `"filename"` is the complete file name (path, file name and extension) to the file that you want to delete. The file must be located on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

Example

```
delete("/test_dir/wvfrms/sine2x.wfm")
```

Diff( )

The diff() statement performs a differentiation operation on a specified file. The output file retains all marker values of the input file. Refer to *Differentiation* on page F-1 for information about the differentiation algorithm.

Group Waveform

Syntax

```
"output_filename" = diff("filename")
```

Arguments `"output_filename"` is the complete file name (file name and extension) to contain the resultant waveform. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename"` is the complete (file name and extension) name of the file on which you are performing the differentiation operation. The file must be on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

Example

```
"diffwave.wfm" = diff("log_swp.wfm")
```


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Expand( )

The Expand() statement horizontally expands (scales) the waveform and marker data of the specified waveform file and writes it to a new file.

Group Waveform

Syntax
```
"output_filename" = expand("filename", expand_multiplier)
```

Arguments `"output_filename"` is the complete file name (file name and extension) to contain the expanded waveform and marker data. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename"` is the complete (file name and extension) name of the file on which you are performing the expand operation. The file must be on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`expand_multiplier` is an integer value specifying how much to expand the waveform data. The value must be greater than one. Values less than or equal to one result in the output waveform being the same as the input waveform.

Example
```
"longswp.wfm" = expand("lin_swp.wfm", 2)
```

Extract( )

The extract statement extracts the specified portion of a waveform file and writes it to a new file. The marker data is also extracted. Specify the start and end points to extract the data. Waveform data starts at point 0.

Group Waveform

Syntax
```
"output_filename" = extract("filename", start_point, end_point)
```

Arguments `"output_filename"` is the complete file name (file name and extension) to contain the extracted waveform and marker data. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename"` is the complete (file name and extension) name of the source file for the extract operation. The file must be on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

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start_point is the location of the first data point to extract from the input file. This is an integer value. The starting point value must be less than or equal to the ending point value or an error occurs during compilation.

end_point is the location of the last data point to extract from the input file. This is an integer value. The ending point value must be greater than or equal to the starting point value or an error occurs during compilation.

NOTE. *This command lets you create a waveform file that does not meet the instrument waveform minimum data requirement (minimum of 960 points, evenly divisible by four). If you create such a file, open it in a waveform editor, and then attempt to save it, the instrument displays a dialog box asking you to correct the problem. If you attempt to load the waveform in the Setup screen, the instrument displays an error message stating that the file does not have enough data points.*

Example

```
"shortsin.wfm" = extract("sine.wfm", 0, 511)
```

For (Control Statement)

The for (control statement) provides a structure for executing one or more equation expressions a defined number of times.

Group Control

Syntax

```
for <var> = <start> to <end> <expr> next
for <var> = <start> to <end> step <incr> <expr> next
```

Arguments

var is a variable name to contain the for loop count value. A common variable name used for this purpose is i. As long as the value of var is true (between the start and end values, inclusive), the program executes the expression(s) in the for loop. When var is false (var > end for incr > 0, and var < end for incr > 0), program flow jumps to the line immediately following next.

start is a value or expression that defines the starting number (integer or real) of the for statement loop count.

end is a value or expression that defines the end number (integer or real) of the for statement loop count.

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incr is a value or expression used with the optional step keyword to define the size of the loop count increment steps. By default the loop counter increments in steps of 1. The incr can be a negative value in which the loop count decrements steps. The increment value is a real or integer number.

NOTE. *Although the start, end, and incr arguments accept real numbers, their values are rounded off to the nearest integer value.*

expr is one or more equation expressions that are executed when the for loop condition is true.

Example

```
for i = nsht to (size - nsht -1) step 1
    sp = i - nsht
    ep = i + nsht
    "TEMP1.WFM" = extract("NOISE.WFM", sp, ep)
    "TEMP2.WFM" = "TEMP2.WFM" / nump
next
```

Hpf( )

The hpf() statement creates a new file by passing the specified waveform file through a high–pass filter.

Group Waveform

Syntax

```
"output_filename" = hpf("filename1", cutoff_freq, taps, atten)
```

Arguments

"output_filename" is the complete file name (file name and extension) to contain the filtered waveform data. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

"filename1" is the complete (file name and extension) name of the source file for the high–pass filter operation. The file must be on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

cutoff_freq is the high–pass filter cutoff frequency. You can enter the value as a real or scientific notation number. You can also enter the value as an expression that resolves to a valid number.

taps is the number of delay elements that composes the digital filter. The range of taps is 3 to 101. You must enter the integer value as an odd number.

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atten is the inhibit zone attenuation factor, in dB. The range of attenuation is 21 dB to 100 dB. You can enter the integer value.

Example

```
"filtered.wfm" = hpf("sine.wfm", 3.25e5, 2, 25)
```

If (Control Statement)

The if(control statement) provides control statements to execute expressions when a condition resolves to true or false.

Group Control

Syntax

```
if <condition> then <expr1> endif
if <condition> then <expr1> else <expr2> endif
```

Arguments

condition is a conditional expression that resolves to a logical true or false. True equals any nonzero value; false equals zero. When the condition is true, the expression statement is run.

expr1 is an equation expression you want to execute when condition is true.

expr2 is an equation expression you want to execute when condition is false. This argument is only valid as part of the else statement of an if/then/else/endif control construct.

Example

```
if cc = 1 then
    ”SMOOTH.WFM” = ”TEMP2.WFM”
  else
    ”SMOOTH.WFM” = join(”SMOOTH.WFM”, ”TEMP2.WFM”)
  endif
```

Integ( )

The integ() statement performs an integration operation on a specified file. The output file retains all marker values of the input file. Refer to *Integral* on page F-3 for information about the integration algorithm.

Group Waveform

Syntax

```
"output_filename" = integ("filename")
```


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Arguments `"output_filename"` is the complete file name (file name and extension) to contain the resultant waveform. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename"` is the complete name (path, file name and extension) of the source file for the integration operation. The file must be on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

Example

```
"intwave.wfm" = integ("sineswp.wfm")
```

Join( )

The join() statement joins (concatenates) two waveform files (waveform and marker data) into a single file. The clock sample rate in first file sets the clock sample rate for the output file waveform. You can only concatenate waveform (*.wfm*) files.

Group Waveform

Syntax

```
"output_filename" = join("filename1", "filename2")
```

Arguments `"output_filename"` is the complete file name (file name and extension) to contain the concatenated files. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename1"` and `"filename2"` are the complete names (path, file name, and extension) of the files you are concatenating. Both files must be on the active drive. The argument can include a relative or absolute path name. Enclose each file name within double quotation marks.

Example

```
"newsine.wfm" = join("sine.wfm", sine2.wfm")
```

Lpf( )

The lpf() statement creates a new file by passing the specified waveform file through a low pass filter.

Group Waveform

Syntax

```
"output_filename" = lpf("filename1", cutoff_freq, taps, atten)
```


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Arguments

`"output_filename"` is the complete file name (file name and extension) to contain the filtered waveform data. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename1"` is the complete (file name and extension) name of the source file for the low pass filter operation. The file must be on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`cutoff_freq` is the low pass filter cutoff frequency. You can enter the integer value.

`taps` is the number of delay elements that composes the digital filter. The range of taps is 3 to 101. You must enter the integer value as an odd number.

`atten` is the inhibit zone attenuation factor, in dB. The range of attenuation is 21 dB to 100 dB. You can enter the integer value.

Example

```
"filtered.wfm" = lpf("sine.wfm", 10.454e2, 2, 30)
```

Math Functions

Table 3-47 lists the programming language math functions that you can use as part of a waveform equation expression.

Table 3-47: Programming language math functions

Function	Description
abs(*a*)	Absolute value of *a*.
acos(*a*)	Arc cosine of *a*.
asin(*a*)	Arc sine of *a*.
atan(*a*)	Arc tangent of *a*.
ceil(*a*)	Minimum integer greater than or equal to *a*.
cos(*a*)	Cosine of *a*.
cosh(*a*)	Hyperbolic cosine of *a*.
exp(*a*)	Exponential function of base of natural logarithm for *a*.
floor(*a*)	Maximum integer less than or equal to *a*
int(*a*)	Truncation (Same as floor(*a*) if *a* >= 0; same as ceil(*a*) if *a* < 0)
log(*a*)	Natural logarithm of *a*.
log10(*a*)	Base 10 logarithm of *a*.
max(*a, b*)	Returns larger (maximum) value of *a* and *b*.

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Table 3-47: Programming language math functions

Function	Description
min(*a, b*)	Returns smaller (minimum) value of *a* and *b*.
noise()	Generates pseudo Gaussian distribution white noise signal with a standard deviation (= RMS) of 1.
pow(*a,b*)	Exponentiation (*b*th power of *a*, or *a*^*b*) A negative value may be specified for *a* only if *b* is an integer. Otherwise, NaN will result. The pow function returns one of the following values: If *b* = 0: Always 1 If *b* ≠ 0 and *a* = 0: Always 0 If *b* ≠ 0 and *a* < 0 and b is a positive integer: a*b If *b* ≠ 0 and *a* < 0 and b is a negative integer: Reciprocal of a*(-b) If *b* ≠ 0 and *a* < 0, NaN (Not a Number)
rnd()	Returns a random number in the 0 to 1 range. Generated base seed = (253 * seed + 1)% 16777216, return seed/16777216. Seed is a 32–bit unsigned integer.
round(*a*)	Rounds off the value of *a* to an integer.
saw(*a*)	Saw tooth wave with a cycle of 2π and an amplitude ±1. If a = -2π, 0, 2π, 4π, or 6π, etc., the value is -1. The value approaches 1 at points immediately before these. (This function will not take the value 1.0.)
sign(*a*)	Sign of *a* (1 if a > 0; –1 if a < 0; 0 if a = 0).
sin(*a*)	Sine value of *a*.
sinc(*a*)	Same as sin(*a*)/*a*, except that 1 results if *a*=0.
sinh(*a*)	Hyperbolic sine value of *a*.
sqr(*a*)	Rectangular wave with a cycle of 2π and an amplitude ±1. If k is an even: For *a* = kπ to (k+1)π, sqr returns -1, except +1.0 when *a* equals (k+1)π. If k is an odd: For *a* = kπ to (k+1)π, sqr returns +1, except -1.0 when a = (k+1)π.
sqrt(*a*)	Square root value of *a*.
srnd(*seed*)	Sets the random number generator seed value. Seed is 0 to 2^{31}-1. Default value is 0.
tan(*a*)	Tangent value of *a*.
tanh(*a*)	Hyperbolic tangent value of *a*.
tri(*a*)	Triangular wave with a cycle of 2π and an amplitude ±1. If *a* = 0, the value is 0. If *a* = 0.5π, it is 1.0. If *a* = π, it is 0.0. If *a* = 1.5π, it is -1.

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Math Operators

Table 3-48 lists the programming language math operators that you can use as part of waveform equation expressions.

Table 3-48: Math operators

Operators	Description
Unary Arithmetic Operations	
-	Inverts the sign.
+	Does nothing.
Binary Operations	
+	Addition
-	Subtraction
*	Multiplication
/	Division
^	Exponentiation
Binary Relational Operations	
=	If both side values are equal, 1 results. Otherwise, 0 results.
<>	If both side values are not equal, 1 results. Otherwise, 0 results.
>	If the left side value is larger than the right side value, 1 results. Otherwise, 0 results.
>=	If the left side value is larger than or equal to the right side value, 1 results. Otherwise, 0 results.
<	If the left side value is smaller than the right side value, 1 results. Otherwise, 0 results.
<=	If the left side value is smaller than or equal to the right side value, 1 results. Otherwise, 0 results.
Binary Conditional Operator	
and	If both side values are not 0, 1 results. Otherwise 0 results.
or	If both side values are 0, 0 results. Otherwise 1 results.

The operator priorities are as follows, starting with higher priority at the top of the list. Operators on the same line have equal priority.

^
- (unary), + (unary)
*, /
=, <>, >, >=, <, <=
and, or

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NOTE. *Exponentiation executes the same calculation as for the pow() function. Zero (0) divided by 0 is 1.*

Norm( )

The norm() statement performs a normalization operation on a specified file waveform data. Normalization scales the waveform values to a ±1.0 range, centered on 0. The output file retains all marker values of the input file.

Group Waveform

Syntax `"output_filename" = norm("filename1")`

Arguments `"output_filename"` is the complete file name (file name and extension) to contain the resultant waveform. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

`"filename1"` is the complete (file name and extension) name of the file on which you are performing the normalization operation. The file must be on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

Example

```
"intwave.wfm" = norm("sineswp.wfm")
```

Pn( )

The pn() statement creates a pseudo–random waveform using a shift register. You can specify the register size (1 to 32) and XOR feedback tap position. The initial values of the registers are set to one. If you omit the tap position specifier, a default maximum data length tap setting is used.

Group Waveform

Syntax `"output_filename" = pn(reg_size [, tap_position ...])`

Arguments `"output_filename"` is the complete file name (file name and extension) to contain the pseudo–random waveform. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

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reg_size specifies the number of registers in the pseudo–random generator. This is an integer value from 1 to 32.

tap_position specifies the register positions to 'tap' for XOR feedback to the register input. A tap does an XOR operation on the output signal and the specified register and passes the result to the next–lower tap position or the register input (register 1), whichever it encounters first. Refer to *Shift Register Generator...* on page 3-66 for more information.

Example

```
"random.wfm" = pn(12, 3, 6, 8)
```

Rename( )

The rename statement renames the specified file name to a new file name and/or location on the current drive.

Group Waveform

Syntax

```
rename("source_file", "target_file")
```

Arguments

"source_file" is the complete file name (path, file name and extension) to the file that you want to rename. The file must be located on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

"target_file" is the complete file name (path, file name and extension) to the location to which you are renaming the source file. The target file must be located on the active drive. The argument can include a relative or absolute path name. Enclose the file name within double quotation marks.

Example

```
rename("/test_dir/sine.wfm", "/test_dir/old_sine.wfm")
```


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Variables (predefined)

The following table lists predefined programming language variables that you can use as part of a waveform equation expression (except where noted).

Table 3-49: Predefined variables

Function	Description
clock	Sets the current instrument sample clock rate.
fname.clock	Returns the sample clock rate of the specified file name. You cannot use this variable in a waveform expression.
pi	The Ludolphian number π.
point	Current data point number value, starting at 0. Read only. Only useable within an equation expression.
scale	Returns the current scale value that increase 0 to 1. Read only. Only useable within an equation expression.
size	Sets the current waveform record length.
fname.size	Returns the number of waveform data points of the specified file name. You cannot use this variable in a waveform expression.
time	Current data time value, starting at 0. Read only. Only useable within an equation expression.

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Write( )

The write() statement writes the specified text to a new file name and/or location on the current drive. If an output file already exists, the source file contents are appended to the end of the existing file.

Group Waveform

Syntax

```
write("output_filename", "text" [,"text" ...])
```

Arguments `"output_filename"` is the complete file name (path, file name, and extension) to the file that you want to write. The file must be located on the active drive. The argument can include a relative or absolute path name. Enclose the file name in double quotation marks.

`"text"` is the text string enclosed in double quotation marks. If you need to use a double quotation mark as part of the text, precede each double quotation character with a slash character (\). For example:

```
This function writes a text to a \"ABC.TXT\" in text form."
```

In a similar way, the following codes can be used in text strings:

\n — LF
\r — CR
\t — Tab
\\ — Backslash
\” — Double–quote

Example

```
write("sine.wfm", "This is comment line.")
```


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Programming Examples

The following eight equation programming examples are described below.

Examples	Key points to be learned
Example 1	Describes how to create waveform file, and how to read and write waveform files.
Example 2	Describes how to use *for* loop and *if* conditional branch statements.
Example 3	Describes how to put comments, and how to create sequence file.
Example 4	Describes how to use marker data and how to use the binary relational operations in the assignment statement.
Example 5	Describes how to use digital filter functions.
Example 6	Describes how to use *data()* and *code()* functions.
Example 7	Describes how to handle specific point data in the waveform file using the *extract()*, *join()* and *integ()* function, and also the *for* and *if* statement.
Example 8	Creates the equation file to generate the four waveforms and two sequence files used in the Sequence editor tutorial in the *Getting Started* section.
Others	Refer to *Appendix D:Sample Waveforms* for more equation examples. Most of the waveforms in the appendix were created by the listed equations.

Example 1 The example below creates three waveform files: *a.wfm*, *b.wfm* and *c.wfm*.

```
size = 2000
"a.wfm" = cos (2 * pi * scale)

size = 1512
"b.wfm" = cos (2 * pi * scale)
"c.wfm" = "a.wfm" * "b.wfm"
```

The first and third lines define the waveform record length (in points). You can change the record length any time within an equation; all created files use the last–set size value. When you do not define the waveform record length, the instrument uses the default length of 1000.

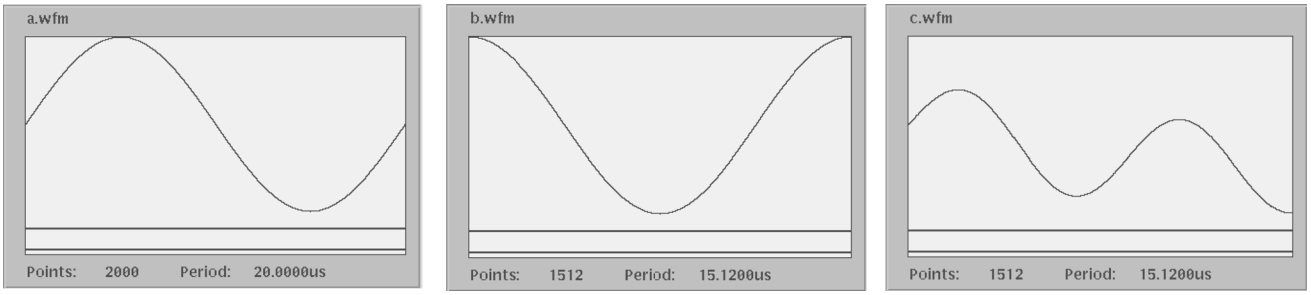
The second line generates the waveform *a.wfm* with 2000 data points. The *scale* is the system–used variable to fit the generated waveform within the ±1.0 vertical scale range.

The waveform *c.wfm* has the point size of 1512 and is generated by multiplying the *a.wfm* and *b.wfm* waveforms.

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When you perform the operation between the waveforms which have a different point size, the lowest point size among them is used. Therefore the c.wfm will have the point size of 1500.

Figure 3-63 shows the waveforms to be generated by the above example.



a.wfm b.wfm c.wfm

Figure 3-63: Waveforms generated from the Example 1 equation

Example 2 Below is an example in which the *for* and *if* statements are used.

```
num = 30

    for i = 1 to num
            if i = 1 then
                    "t.wfm"=cos(2*pi*scale)
            else
                    "t.wfm"="t.wfm"+cos(2*pi*i*scale)
            endif
    next

    "t.wfm"="t.wfm"/num
```

Num and *i* are user–defined variables. *I* is used as part of the *for* loop parameter. The statements placed between the *for* and *next* keywords repeat 30 times while the *i* increments by 1 for each loop.

The conditional branch statement must start with the *if* keyword and end with the *endif* keyword. In the above example, if $i = 1$, the equation creates the waveform *t.wfm*. When $i \neq 1$, the newly created waveform and the one created in the previous loop are added, and the result is stored in the waveform *t.wfm*. The resultant waveform is then normalized.

Figure 3-64 shows the waveform generated by the previous example.

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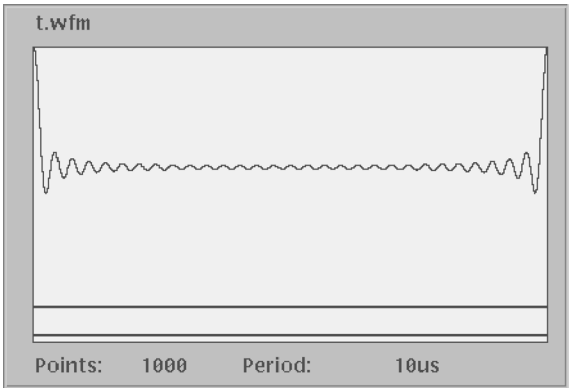


Figure 3-64: Waveform generated by the Example 2 equation

Example 3 The following example creates one sequence file and four waveforms.

```
delete("test.seq")

size=1000
clock=1e9
num=4

'write sequence file header

write("test.seq","3002A\n")
write("test.seq","LINES ":num:"\n")

for i = 1 to num

    'create a waveform file
    "test":i:".wfm" = sin(2 * pi * i * scale)

    'add line to sequence file
    rep = num * i
    write("test.seq","\"test":i:".wfm\",\"\",":rep:"\n")
next
```

The first line is the statement for deleting the existing waveform. If that file does not exist, then no action is taken.

The *size* and *clock* keywords are the system valuables representing the waveform record length, in points, and the sampling clock frequency. They are set to 1000 points and 1.0 GS/s in the above example.

The comment text on line 5 starts with a single quotation (') character. Comment text is effective until the end of the line containing the single–quote character.

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The *write* command writes the specified text to the specified file. If the file being written to exists, the write command appends the specified string to the end of the file. The first argument is the file to which the strings specified as the second argument and after will be written. The string must be enclosed in double quotation marks. If you desire to use a variable as a string, you must place the colon (:) before and after the variable. For example:

```
"text":i:".wfm"
```

In the above example, if the variable *i* is currently 5, the value of the string will be *text5.wfm*. The slash is used as an escape character, and precedes the double quotation marks in a string. The '\n' inserts an end of line (EOL) character in the file.

The sequence file is a text file which has the number 3002 on the first line of the text and the number of lines (for example LINES 4) on the second line.

Figure 3-65 shows the four waveforms generated by example 3. Figure 3-66 shows the sequence table created by example 3.

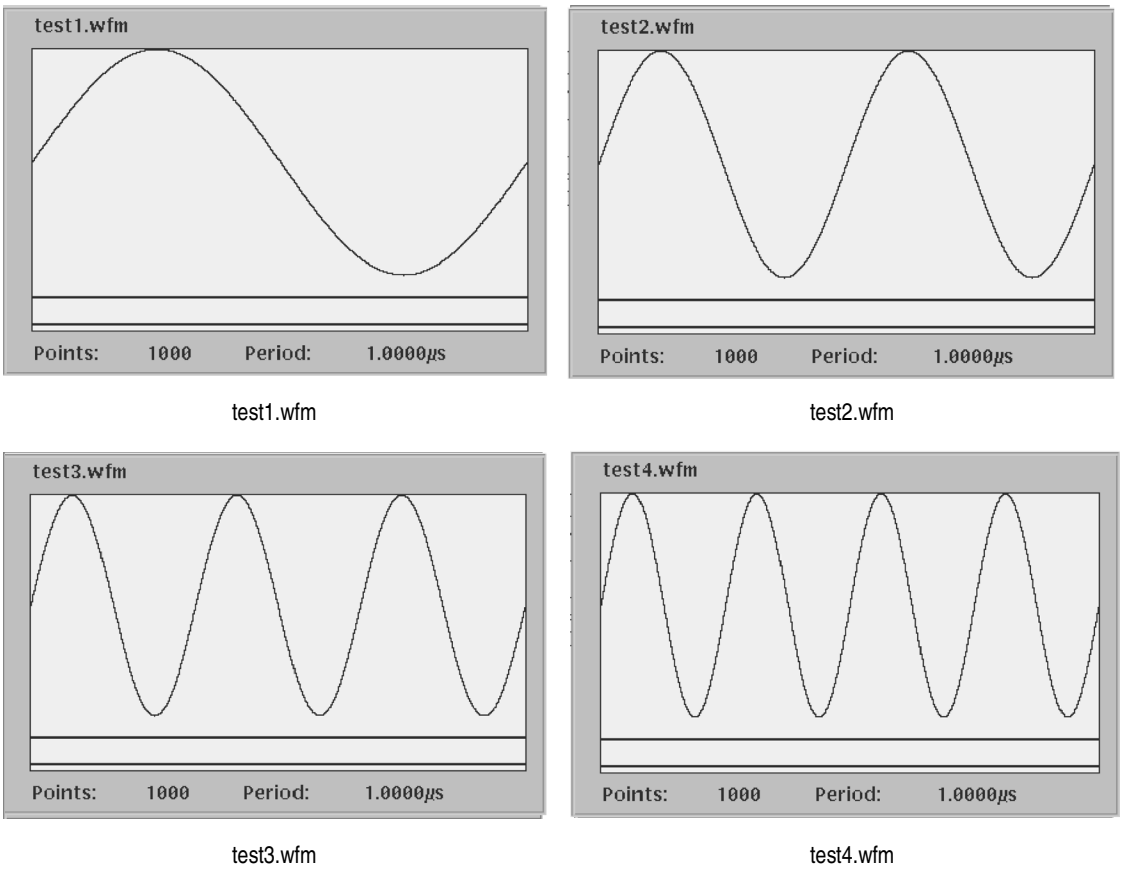


Figure 3-65: Waveforms generated by the Example 3 equation

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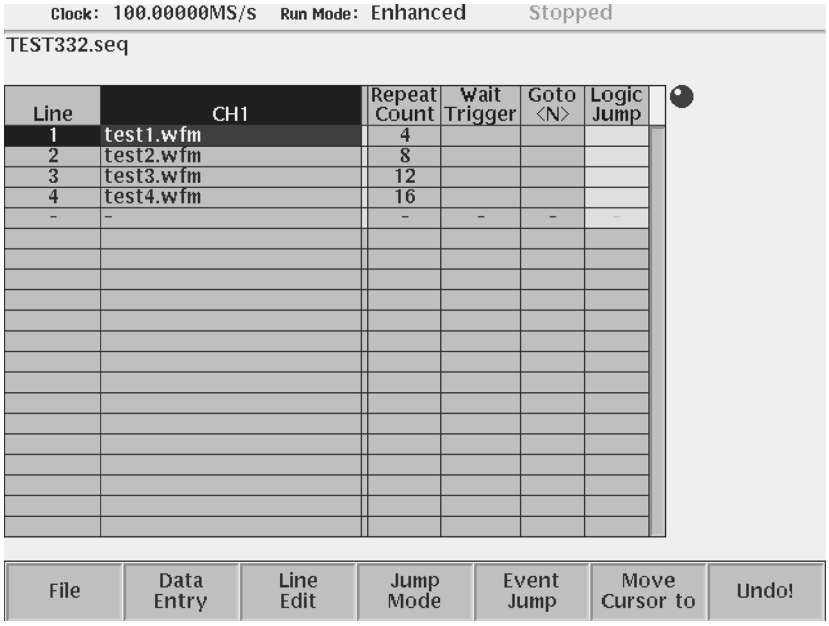


Figure 3-66: Sequence generated by the Example 3 equation

NOTE. *The equation/text editor has a viewer that displays the waveforms after the compile has been performed. However, this viewer cannot display the sequence. Use the sequence editor to confirm the results.*

Example 4

The following example shows how to use boolean relational operations between a waveform and its marker data.

```
delete("MOD01.WFM")
delete("MOD02.WFM")

"Mod.wfm" = sin (2 * p  * scale)

"MOD01.WFM" = "MOD.WFM"

"MOD01.WFM".marker1 = "MOD01.WFM" >= 0.5
"MOD01.WFM".marker2 = "MOD01.WFM" <= -0.5

"MOD02.WFM" = ("MOD01.WFM".marker1 = "MOD01.WFM".marker2) / 2
```

The boolean relational operation results in a 1 value if the condition is true, and a 0 value if the condition is false. Therefore the MOD01.WFM marker1 signal is 1 if the waveform data is greater than or equal to 0.5, and 0 for all other values. Likewise, the marker2 signal is 1 if the waveform data is less than or equal to -0.5, and 0 for all other values.

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The MOD02.WFM signal is 0.5 if the marker1 signal of the MOD01.WFM is equal to the marker2 signal, otherwise the signal value is 0.

The results are shown in Figure 3-67.

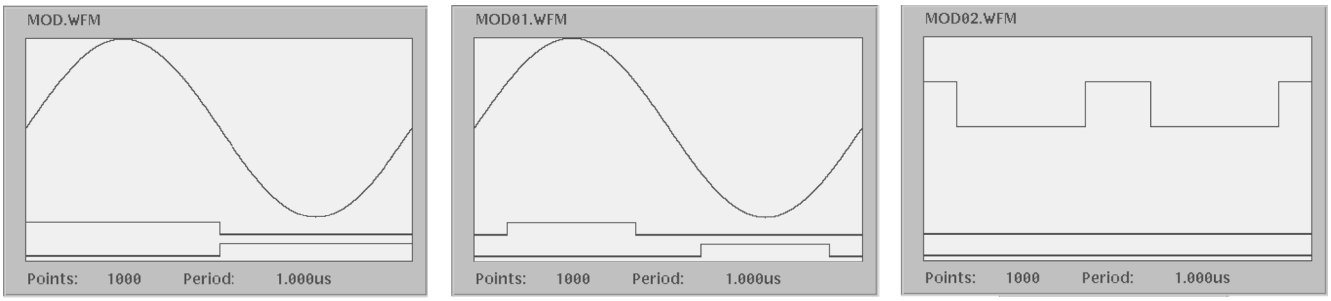


Figure 3-67: Source waveform and those generated by the Example 4 equation

Example 5 The following example shows how to use filter functions. There are four digital filter functions: lpf(), hpf(), bpf() and brf(), which are the same as those provided in the digital filter dialog box of the waveform editor. Refer to *Digital Filter...* on page 3-78 for more information on the filter arguments and the digital filter characteristics.

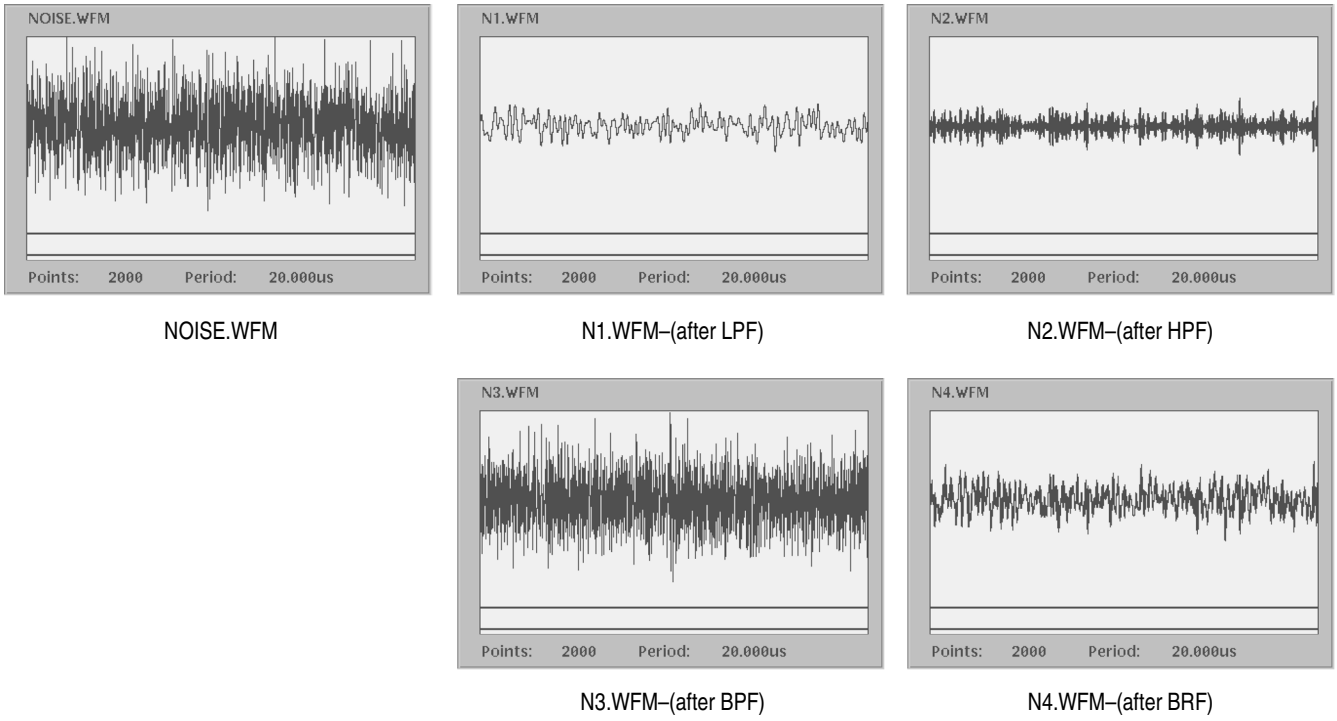
```
size = 2000

hf = 45e6       ' Cutoff frequency High: 1 Hz to 50 MHz
lf = 5e6        ' Cutoff frequency Low: 1 Hz to 50 MHz
taps = 97       ' Taps: 3 to 101
att = 30        ' Attenuation: 21 dB to 100 dB

"NOISE.WFM" = noise()
"NOISE.WFM" = norm("NOISE.WFM")

"N1.WFM" = lpf("NOISE.WFM", lf, taps, att)
"N2.WFM" = hpf("NOISE.WFM", hf, taps, att)
"N3.WFM" = bpf("NOISE.WFM", lf, hf, taps, att)
"N4.WFM" = brf("NOISE.WFM", lf, hf, taps, att)
```


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NOISE.WFM N1.WFM–(after LPF) N2.WFM–(after HPF)

N3.WFM–(after BPF) N4.WFM–(after BRF)

Figure 3-68: Noise waveforms after filtering

Example 6 The following example shows a code conversion. In this example, two kinds of data are created with *data()* function. You need to prepare the code conversion tables which can be created with the text editor or Code Convert Table dialog box. The Code Convert Table dialog box is brought up by pushing **Tools** (bottom)→**Code Convert...** (pop–up)→ **OK** (side)→**Edit...** (side) from the waveform or pattern editor.

```
"C0.WFM" = data(0, 1, 0, 0, 1, 1, 0, 0, 0)

"C1.WFM" = code("C0.WFM", "nrz.txt")
"C2.WFM" = code("C0.WFM", "nrzi.txt")
"C3.WFM" = code("C0.WFM", "nrzi-2.txt")
"C4.WFM" = code("C0.WFM", "fm.txt")
"C5.WFM" = code("C0.WFM", "bi-phase.txt")
"C6.WFM" = code("C0.WFM", "rz.txt")
"C7.WFM" = code("C0.WFM", "special.txt")

"C0.WFM" = data(0,1,1,0,1,1,0,0,1,0,1,0,0,0,1,1,1,1,0,
0,0,1,0,0,1,1,1,0,0,0,0,0)
"C8.WFM" = code("C0.WFM", "1-7rill.txt")
```


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The waveforms generated by the previous equation file are composed of 0 and 1. It is convenient to use the waveform editor in table mode to look at the results. Refer to *Code Conversion* on page F-7 for the input patterns, output patterns and code conversion tables.

Example 7 The following example applies a 7–point smoothing operation to a noise waveform. This equation uses the *extract()*, *integ()* and *join()* functions, and also *for* and *if* control statements. Although you do not have any other method to perform smoothing with the instrument, this is not a preferable way to apply a smoothing operation. Refer to this example for learning how to use these functions and control statements.

You can change the number of smoothing points by changing the value of the variable nump. The greater the value of nump, the faster the instrument can finish the compile. However, this kind of program frequently accesses the hard disk and takes more than 20 minutes to complete.

```
´ Simple smoothing (7 points)

nump = 7
extp = nump - 1
nsht = extp / 2
size = 960

"NOISE.WFM" = noise()
"NOISE.WFM" = norm("NOISE.WFM")

cc = 1
for i = nsht to (size - nsht -1) step 1
    sp = i - nsht
    ep = i + nsht
    "TEMP1.WFM" = extract("NOISE.WFM", sp, ep)
    "TEMP1.WFM" = integ("TEMP1.WFM")
    "TEMP2.WFM" = extract("TEMP1.WFM", extp, extp)
    "TEMP2.WFM" = "TEMP2.WFM" / nump
    if cc = 1 then
        "SMOOTH.WFM" = "TEMP2.WFM"
    else
        "SMOOTH.WFM" = join("SMOOTH.WFM", "TEMP2.WFM")
    endif
    cc = cc + 1
next

delete("TEMP1.WFM")
delete("TEMP2.WFM")
```


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The following text describes what happens in this example:

1. The *noise()* function generates a noise waveform into the file NOISE.WFM, in which the waveform data are normalized using the norm() function.
2. The *extract()* function extracts the data sp through ep and stores them into the file TEPM1.WFM.
3. The *integ()* function integrates the 7 data. The data of last point is the amount of 7 point data. This last data is divided by 7 and then concatenated to the file SMOOTH.WFM.
4. The *for* statement shifts the points to be read by one point for each loop and repeats these procedures.

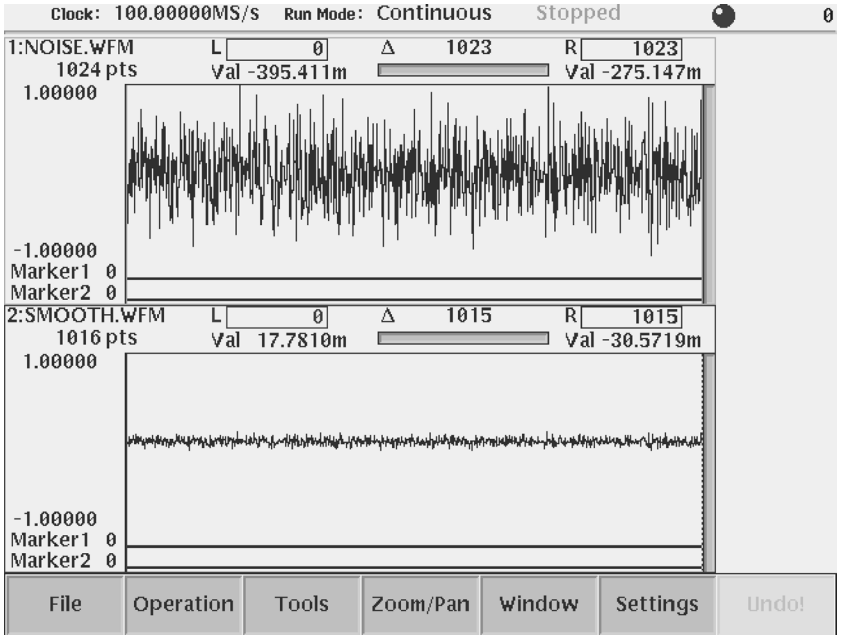


Figure 3-69: Noise waveforms before (upper) and after (lower) 7–point smoothing

Example 8 The following example creates two sequence files and five waveform files. These files are the same as those used in the *Tutorial 6: Creating and Running Waveform Sequences* beginning on page 2-70.

```
' Tutorial 6

delete("MAINSEQ.SEQ")
delete("SUBSEQ.SEQ")
```


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```
size = 1000
clock = 1e8
num = 4

' Sub-sequence
write("SUBSEQ.SEQ", "MAGIC 3002A\n")
write("SUBSEQ.SEQ", "LINES ":num:"\n")
write("SUBSEQ.SEQ", "\"SQUARE.WFM\",\"\",40000\n")
write("SUBSEQ.SEQ", "\"RAMP.WFM\",\"\",60000\n")
write("SUBSEQ.SEQ", "\"TRIANGLE.WFM\",\"\",60000\n")
write("SUBSEQ.SEQ", "\"SINE.WFM\",\"\",30000\n")

' Main sequence
write("MAINSEQ.SEQ", "MAGIC 3002A\n")
write("MAINSEQ.SEQ", "LINES ":num:"\n")
write("MAINSEQ.SEQ", "\"SUBSEQ.SEQ\",\"\",2,1,0,0\n")
write("MAINSEQ.SEQ", "\"RAMP.WFM\",\"\",0,0,0,-1,0\n")
write("MAINSEQ.SEQ", "\"TRIANGLE.WFM\",\"\",40000,0,0,4,1\n")
write("MAINSEQ.SEQ", "\"SINE.WFM\",\"\",60000,0,0,0,0\n")
write("MAINSEQ.SEQ", "TABLE_JUMP
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,\n")
write("MAINSEQ.SEQ", "LOGIC_JUMP -1,-1,-1,-1,\n")
write("MAINSEQ.SEQ", "JUMP_MODE LOGIC\n")
write("MAINSEQ.SEQ", "JUMP_TIMING ASYNC\n")
write("MAINSEQ.SEQ", "STROBE 0\n")

' Standard functions
"GAUSSN.WFM"   = noise()
"SINE.WFM"     = sin(2 * pi * scale)
"RAMP.WFM"     = 2 * scale -1
"TRIANGLE.WFM" = tri(2 * pi * scale)
"SQUARE.WFM"   = sqr(2 * pi * scale)
```

See Figure 2-45 on page 2-75 to see the contents of the *subseq.seq* file, and Figure 2-49 on page 2-80 to see the contents of the *mainseq.seq* file.
Figure 3-70 on page 3-217 shows the *gaussn.wfm* and *ramp.wfm* waveforms created in above equation.

Refer to *Appendix G: Sequence File Text Format* for more information.

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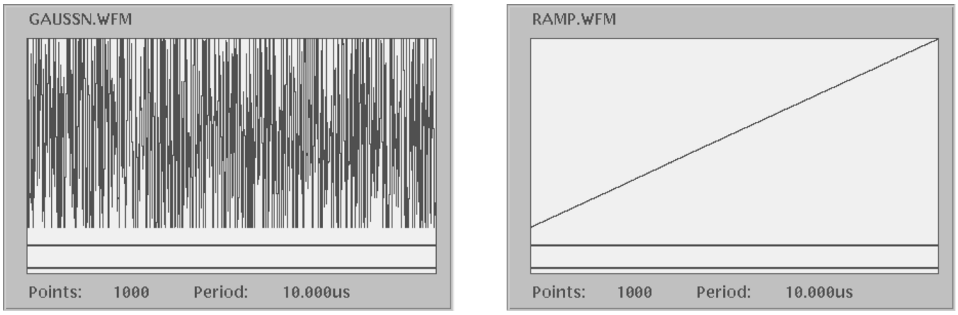


Figure 3-70: Gaussian noise and ramp waveforms

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File Conversion

The AWG710&AWG710B Arbitrary Waveform Generator has the ability to import and export various formats of waveform data. Import converts waveform files created with other instruments into files the AWG710&AWG710B Arbitrary Waveform Generator can use. Export converts AWG710&AWG710B Arbitrary Waveform Generator waveform files into text files.

Each AWG710&AWG710B Arbitrary Waveform Generator waveform file contains the clock rate information, waveform data, and marker information. Import uses default values for the information unavailable through the external file.

Import

The following files can be converted into AWG710&AWG710B Arbitrary Waveform Generator compatible waveform files:

- AWG20xx.WFM to Waveform

  An AWG2000 Series *.wfm* file is converted into an AWG710&AWG710B Arbitrary Waveform Generator waveform file. The marker data and clock rates are inherited.

- AWG20xx.WFM to Pattern

  An AWG2000 Series *.wfm* file is converted into an AWG710&AWG710B Arbitrary Waveform Generator pattern file. The marker data and clock rates are inherited.

  Note that the upper 8 bits in the AWG2021 or AWG2005 waveform file are converted into the AWG710&AWG710B Arbitrary Waveform Generator waveform file. The lower four bits are neglected. In the AWG2041 waveform file, 8–bit data is imported with no convention into the data bits: Data 0 to Data 7 in the AWG710&AWG710B Arbitrary Waveform Generator pattern file.

- TDS.WFM to Waveform

  A waveform file generated with a Tektronix TDS–Series oscilloscope is converted into an AWG710&AWG710B Arbitrary Waveform Generator waveform file. The clock rate and position information are inherited. The offset information is neglected in this conversion.

  The AWG710&AWG710B Arbitrary Waveform Generator is unable to transfer waveforms during some oscilloscope acquisition modes such as Fast Acquisition, for example. Contact Tektronix Technical support for more information.

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- TDS.ISF to Waveform

  A waveform file generated with a Tektronix TDS3000 series oscilloscope Internal File Format is converted into an AWG710&AWG710B Arbitrary Waveform Generator waveform file. The clock rate and position information are inherited. The offset information is neglected in this conversion.

- EASYWAVE.WAV to Waveform

  A data file (*.wav*) generated with LeCroy EASYWAVE software is converted into the AWG710&AWG710B Arbitrary Waveform Generator waveform file. No attributes are inherited.

- Text file to Waveform

  An ASCII–form text file is converted into the AWG710&AWG710B Arbitrary Waveform Generator waveform file. Numeric values separated by separators are loaded. Headers or similar codes are not defined. The separator can be a space, comma, tab, or <CR><LF>.

  An exponential notation (for example, -.1E–2) may be used as a numeric value. A unit prefix (for example, m, u, n, p, k, M) may not be used. If you use a numeric value followed by an alphabetical character (such as, 1.2 V), the value will be interpreted properly, ignoring the alphabetical character.

  If you use a sequence of consecutive separators, it will be interpreted as a single separator.

Therefore, the meaning of the following line:

1,2,3,4<CR> <LF>

is the same as:

1 , 2, , 3,,, 4 ,,, <CR> <LF>

If an alphabetical character (such as A, B, C, and/or D) is placed instead of a numeric value, the value 0 will result. (This is not handled as an error.)

The actual input file formats are as follows:

Format 1: Numeric values that are listed horizontally

0,0.1,0.2,0.3,0.4

The respective values are converted into the analog data. The marker value is converted into 0.

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Format 2: Repetitions of three numeric values listed on a line:

0.1,1,0
0.2,0,1
0.3,0,0

One line corresponds to 1 point. The first value is the analog data, and the subsequent two are markers 1 and 2. For marker data, values larger than 0.5 are regarded as 1, and the others as 0.

Export

AWG710&AWG710B Arbitrary Waveform Generator waveform files can be converted into the following files. You may use a format including marker data and one not including it.

- Waveform to text file
- Waveform to text file with marker

For both file types, 1–point data is written on a line. The return code is CR/LF.

If no marker is included:

1.0
0.5
-0.9
0.1

If markers are included:

1.0,1,1
0.5,0,1
-0.9,1,0
0.1,0,0

Convert between Waveform and Pattern

AWG710&AWG710B Arbitrary Waveform Generator waveform files and pattern files can be converted from one form to the other.

- Waveform to Pattern
- Pattern to Waveform

In this conversion, the marker data is always inherited.

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Executing File Conversion

This command converts the file you selected in the **EDIT** menu. It is available for any file residing on the hard or floppy disk or a remote file system.

1. Push the **EDIT** button on the front panel.

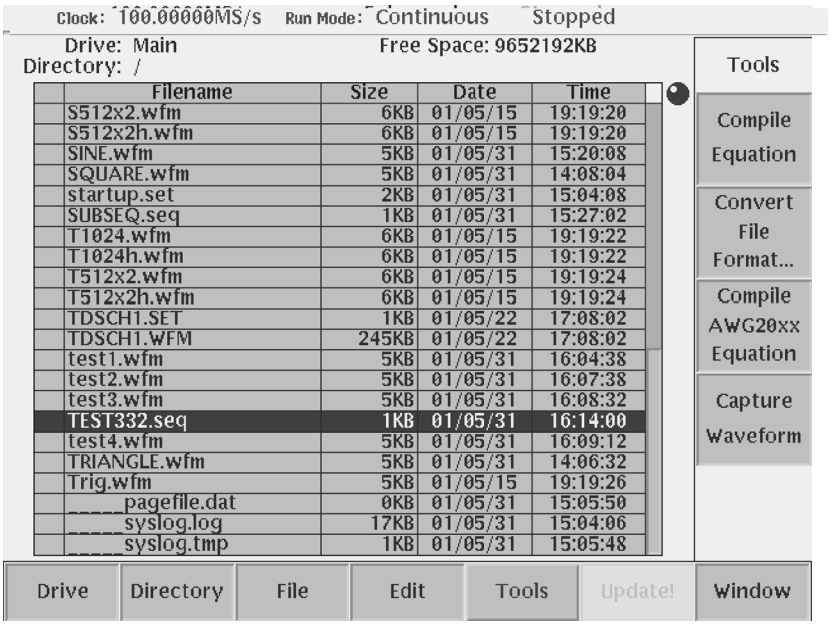


Figure 3-71: Screen and side menu buttons for importing and exporting

2. Select the file you want to convert from the file listing on the screen.
3. Push **Tools** (bottom)→**Convert File Format...** (side). A dialog box appears that lets you select the conversion type. See Figure 3-72.

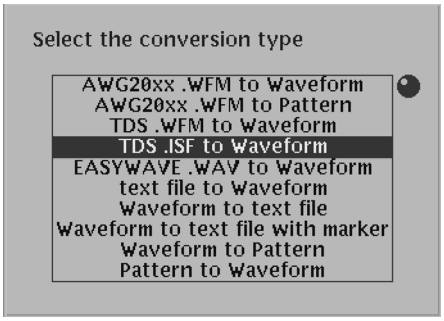


Figure 3-72: Select the conversion type dialog box

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4. Select a conversion type using the general purpose knob or the ▲ or ▼ button.
5. Push the **OK** side button. The Input Filename dialog box appears that lets you specify the converted file name and the destination.
6. Enter a file name and then press the **OK** side button.

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File Management

This section describes the AWG710&AWG710B Arbitrary Waveform Generator file management commands and conventions.

Command Summary

Table 3-50 lists the available file management commands.

Table 3-50: File utility commands

Commands	Descriptions
Copy	Copies a file
Rename	Renames a file or directory
Delete	Deletes a file or directory
Delete All	Deletes all files and directories containing files in the current directory
Attribute	Assigns Read/Write or Read Only attribute to a file
Make Directory	Creates an empty directory
Up Level	Moves to the upper level directory
Down Level	Moves down to a selected directory
Drive	Selects a storage drive

Path Name

You can specify a file or directory location using the absolute path or relative path expression. The AWG710&AWG710B Arbitrary Waveform Generator uses the same file expression as used in the UNIX file system. Table 3-51 shows the characters available for specifying direct or indirect path names.

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Table 3-51: Special symbols used for expressing file path

Symbols	Descriptions
.	Represents current directory
..	Represents higher level directory
/	Represents top level directory (root directory) or delimiter. If the slash appears at the most–left position in a path, the path represents an absolute path. If the slash appears in the middle of a path, the path represents a relative path.

NOTE. *You cannot specify the storage drive as part of a file path name. You must use the menu Drive buttons to specify a drive.*

File Operations

For file operations, you can select Single Window or Double Windows.

In the Double Windows, you can copy or move a file or all files from the currently selected window to the destination specified by the other window. You cannot rename, delete, or assign attribute operations in the Double Windows.

The following text describes how to perform file management tasks.

Selecting a Drive

Drives include the instrument hard disk drive, the instrument floppy disk drive, and up to three drives accessible from the instrument over the Ethernet connection. Do the following steps to select a new source or target drive.

1. Push **EDIT** (front–panel)→**Drive** (bottom).
2. Select a storage drive from the side menu.

NOTE. *The floppy disk file list displayed on the screen does not automatically update when you replace the diskette with another one. Select the floppy disk drive once again to update the file list.*

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Moving Directories

Do the following steps to move to a different directory:

1. Push the **EDIT** button.
2. Select a drive.
3. Push the **Directory** bottom button.
4. Repeat step **3** until you reach the destination directory.

   Push the **Up Level** side button to move a directory up by one level.

   To move a directory down by one level, select the directory from the file listing on the screen, and then push the **Down Level** side button.

Making Directory

Do the following steps to create a new directory:

1. Push the **EDIT** button.
2. Select a drive and/or directory.
3. Push **Directory** (bottom)→**Make Directory** (side).

   The Input Filename dialog box appears.
4. Use the Input Filename dialog box to specify the new directory name and/or destination.

Selecting Files

Do the following steps to select a file:

1. Push the **EDIT** button.
2. Select a file from the file listing on the screen using the ▲ or ▼ buttons or the general purpose knob.

Copying Files

Do the following steps to copy a file:

Copy with Double Windows.

1. Push **Edit** (front-panel). Select the file you want to copy.
2. Push **Window** (bottom) → **Window** (side) and select **Double**. Two windows listing file names are displayed.
3. Push **Select** (side) button to toggle an active window.
4. Push **Directory** (bottom). If necessary, push **Up Level**, **Down Level** or **Make Directory** (side) buttons to move the directory.

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5. Push **Select** (side) button to make the window listing the file to be copied active. Make sure that the file to be copied is selected.
6. Push the **File** (bottom) → **Copy** (side) side buttons. A copied file is displayed in the directory you specified in step **4**.

When the file with the same file name exists in the destination, a message *Overwrite existing file?* appears.

Copy with Single Windows.

1. Push **Edit** (front–panel). Select the file you want to copy.
2. Push **File** (bottom) → **Copy** (side). The Input Filename dialog box is displayed. Specify the file name and destination directory.
3. Push **OK** (side) button. The file is copied to the directory you specified in step **2**.

Moving Files

To move files, use double windows. Do the following steps.

1. Push **Edit** (front-panel). Select the file you want to move.
2. Push **Window** (bottom) → **Window** (side) and select **Double**. Two windows listing file names are displayed.
3. Push **Select** (side) button to toggle an active window.
4. Push **Directory** (bottom) and, if necessary, push **Up Level**, **Down Level** or **Make Directory** (side) buttons to move the directory.
5. Push **Select** (side) button to make the window listing the file to be moved active. Make sure that the file to be moved is selected.
6. Push the **File** (bottom) → **Move** (side) side buttons. A file is moved in the directory you specified in step **4**.

When the file with the same file name exists in the destination, a message *Overwrite existing file?* appears.

You can also perform the ‘move’ operation with single window by using **Copy** and **Delete** commands.

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Renaming Files

Do the following steps to rename a file:

1. Select a file or directory to rename.
2. Push the **Rename** side button.

   The Input Filename dialog box appears.
3. Use the Input Filename dialog box to specify the new file name and the destination.
4. Push **OK** (side) button. The file is renamed to the directory you specified in step **3**.

Deleting One or All Files

Delete removes the selected file. **Delete All** removes all files and empties directories contained in the current directory. These commands do not delete any directories that contain files. When you delete files or directories, the instrument displays a dialog box asking you to confirm the file/directory deletion. Do the following steps to delete one or more files and/or empty directories:

1. Select a file or directory to delete.
2. Push the **Delete** or **Delete All** side button.
3. Push **OK** or **Cancel** (side), depending on the message to confirm deletion.

Assigning Attribute to Files

Attribute prevents a file or directory from unconditional modifications or deletion. This is made by assigning the Read Only or Read/Write attribute to the file. After you assign the Read Only attribute to the file, a key mark appears on the left of the file listing.

1. Select a file to which you want to assign or change an attribute status. All files are assigned read/write status by default.
2. Push the **Attribute** side button to toggle between Read/Write and Read Only, as necessary.

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File Operation in Double Windows

When the Window bottom button is displayed, you can divide the file list in the Edit Screen into two windows as shown in Figure 3-73. This function is called Double Windows.



Figure 3-73: Double Windows

In Double Windows, for example, you can display the file list of the hard disk and the one of the floppy disk, or the file list of a directory and the one of an another directory. All of the functions that are invoked from the bottom buttons are available except for the File function.

The most important functions used in two file lists displayed at the same time are the Copy and Move file operations.

Window Operation

The windows are named as Upper and Lower windows as indicated in Figure 3-73. Select a window for operation.

Push **EDIT** (front) → **Window** (bottom) to display the Window side button. Push the **Window** side button again to select Double for double windows. Push the **Window** side button again to select Single and to return the display back into the signal file list.

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When you display the double windows, the Select side button will be available. Push the **Select** side button to select Upper for file operation in the upper file list window. Push the **Select** side button again to select Lower for file operation in the lower file list window.

Operation in Double Windows

The most useful functions to be used in the double windows may be those invoked from the File bottom button. The functions available in the File bottom button are described in Table 3-52.

Table 3-52: File operation in double windows

Operation	Description
Copy	Copies a file from a selected file list window into the destination specified in the other file list window. You cannot select the directory.
Copy All	Copies all files in a selected file list window into the destination specified in the other file list window. You cannot copy the directory or directory structure.
Move	Moves a file selected in a selected file list window into the destination specified in the other file list window. You cannot select the directory.
Move All	Moves all files in a selected file list window into the destination specified in the other file list window. You cannot move the directory or directory structure.

NOTE. *You cannot use the Rename, Delete, Delete All, and Attribute side buttons unless you display the single file list window.*

In copy or move operation, when the files with the same file name exist in the destination, the message *Overwrite existing file?* appears. At the same time, the **Cancel**, **No**, **Yes to All**, and **Yes** side buttons appear. Press any of these side buttons to proceed.

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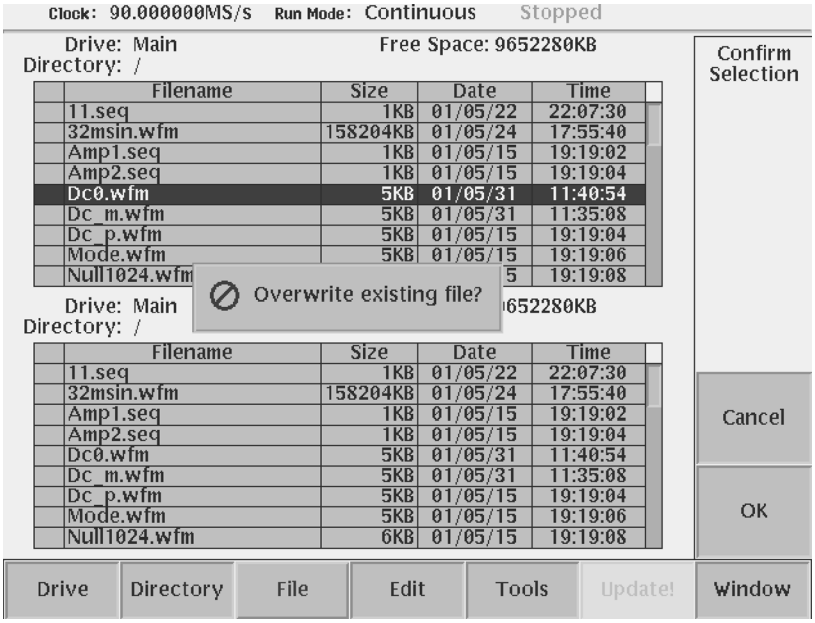


Figure 3-74: Overwrite confirmation

Table 3-53: Confirmation selection for copy–all and move–all operations

Side menu	Description
Cancel	Cancels and stops copy or move operation.
No	Skips the copy or move operation for the file indicated in the message.
Yes to All	Overwrites all the files without displaying any messages until the operation is finished.
Yes	Overwrites the file indicated in the message and proceeds with the operation.

You cannot copy or move a directory. In the copy–all or move–all operation, the message *Directory cannot be copied* appears when you are trying to move or copy a directory. Press the **OK** side button to confirm and proceed with the operation.

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FG Mode

The AWG710&AWG710B Arbitrary Waveform Generator provides the Function Generator (FG) mode to output standard function waveform. This section describes the FG mode.The product which has option 02 doesn't have offset function.

FG mode Signals are created and output using the following process:

- Select the waveform type.
- Set the output parameters such as frequency and amplitude.
- Turn the OUTPUT button to ON.

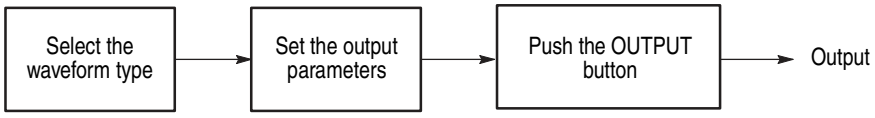


Figure 3-75: Outline flow for producing Function Generator signal

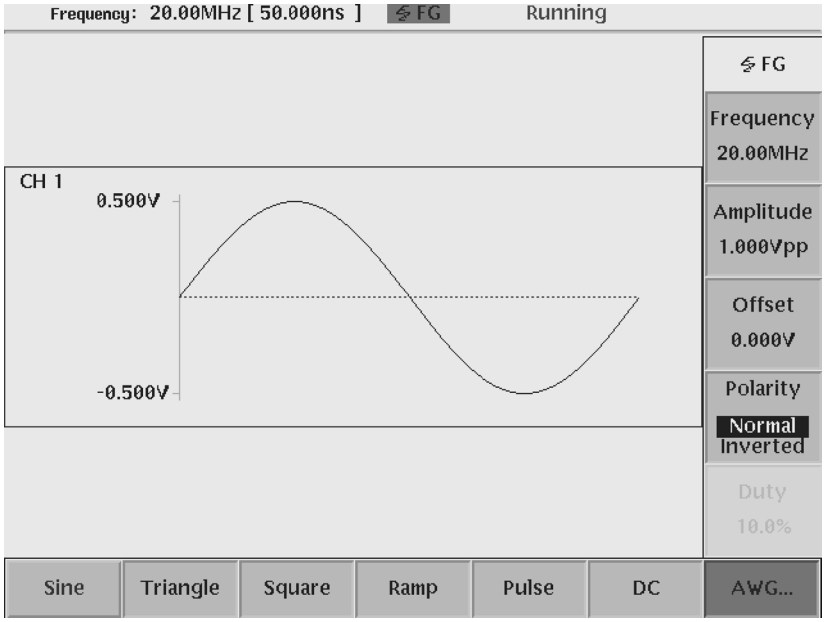


Figure 3-76: FG mode screen (except option 02)

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Change the generator mode

AWG mode to FG mode

The instrument initializes in the AWG mode when powered on.

Do the following to change the generator mode from AWG to FG:

1. Push **SETUP** (front–panel)→**Extended Operation** (bottom)→ **Ez FG...** (side) button.

The instrument displays the FG mode screen.

FG mode to AWG mode

Do the following to change the generator mode from FG to AWG:

1. Push **Exit Ez FG...** (bottom) button.

The instrument returns to the AWG mode.

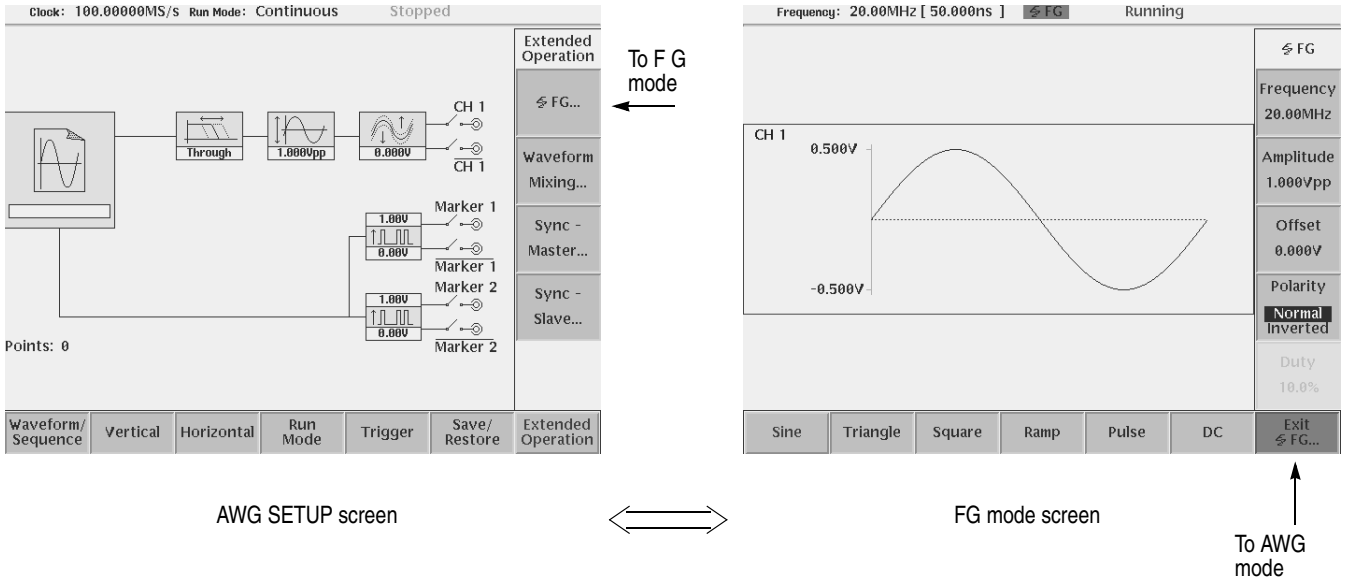


Figure 3-77: Change the generator mode (except option 02)

NOTE. *All the parameters on the FG mode menu are independent of the AWG mode parameters. Therefore, the output parameters, such as frequency, amplitude and offset, have no effect on the parameters set with the SETUP menu while in the other mode.*
In FG mode, the AWG710&AWG710B runs CONTINUOUS mode only.

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Waveform type

Select the Waveform type

You can select Sine, Triangle, Square, Ramp, Pulse and DC waveform.

1. Push **Sine**, **Triangle**, **Square**, **Ramp**, **Pulse** or **DC** (bottom) button to select the desired waveform type.

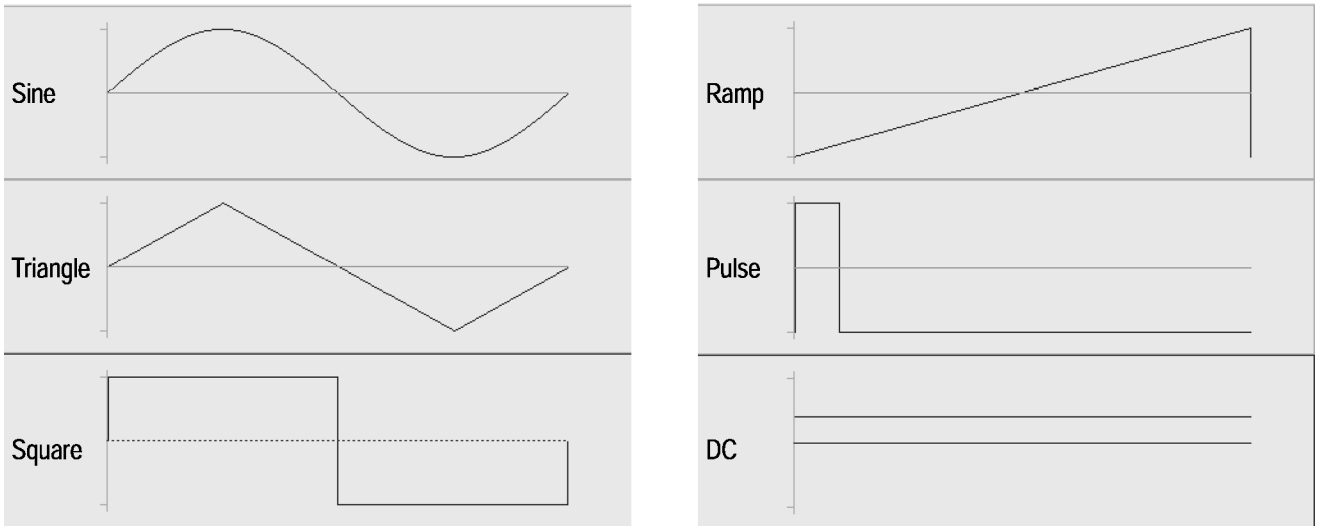


Figure 3-78: Waveform type

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Parameters

Output parameters

The output parameter menu selections are the same for each waveform except Pulse and DC. Pulse has one extra side menu item (Duty), and DC has only one side menu item (Offset). In the case of option 02, output level is fixed in 0V in the DC function.

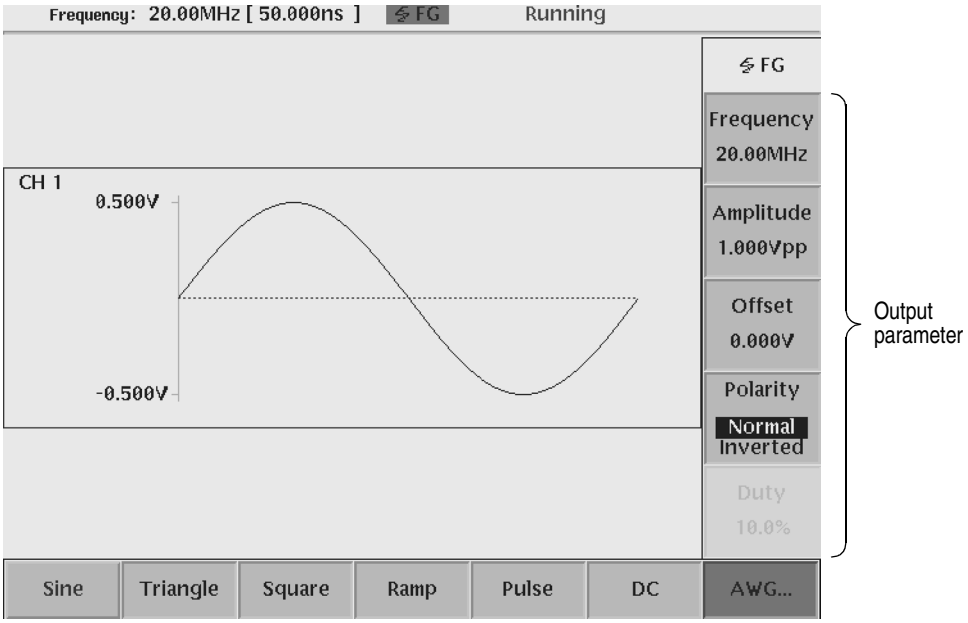


Figure 3-79: Output parameters (except option 02)

Frequency

The frequency is set with a 4–digit number from 1.000 Hz to 400.0 MHz using the SAMPLE RATE / SCALE knob, the numeric buttons or the general purpose knob.

The internal cut–off filter used is determined by the waveform type and the frequency selected. The cut–off frequencies are as follows; (except option02)

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Table 3-54: Output frequency and filter cut–off frequency (except option02)

Waveform type	Output Frequency	Filter Cut-off Frequency
Sine	1.000 Hz to 400.0 kHz	20 MHz
	400.1 KHz to 4.000 MHz	50 MHz
	4.001 MHz to 8.000 MHz	100 MHz
	8.001 MHz to 15.00 MHz	200 MHz

Amplitude

The amplitude output voltage range is from 0.020 $V_{p–p}$ to 2.000 $V_{p–p}$ (Option 02: 0.500 $V_{p–p}$ to 1.000 $V_{p–p}$), in 1 mV increments, terminated into a 50 Ω load. Set the waveform amplitude using the LEVEL / SCALE knob, the numeric buttons or the general purpose knob.

Offset (except option 02)

The offset range is from -0.500 V to +0.500 V, in 1 mV increments. Use the VERTICAL OFFSET knob, the numeric buttons or the general purpose knob to set the waveform offset level.

Offset is also used for setup of DC level.

Polarity

This menu sets the output waveform polarity. Pushing the Polarity menu button toggles polarity between Normal and Inverted.

Duty

When you select Pulse waveform, Duty... side menu is added. The Duty cycle is set from 0.1% to 99.9% using the numeric buttons or the general purpose knob. Increment step size depends on the output frequency. Refer to Table 3-56 on page 3-239.

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Marker signal

Marker1 and Marker2 signals are generated and output from MARKER OUT1, MARKER $\overline{\text{OUT1}}$, MARKER OUT2 and MARKER $\overline{\text{OUT2}}$ connectors. The waveform marker signal has the same form as a pulse waveform. The level and width of the markers are fixed and cannot be changed. Table 3-55 describes the marker specification. Marker width depends on the output frequency. Refer to Table 3-56 on page 3-239.

Table 3-55: Predefined Marker signal

Waveform	Hi	Low	Level
Marker1	0 (phase = 0 deg.) to 20 % of one period of waveform	20 to 100 % of one period of waveform	Hi : 2.0 V:AWG710 1.0 V :AWG710B Low : 0.0V
Marker2	0 (phase = 0 deg.) to 50 % of one period of waveform Frequency: 100.1MHz to 160.0MHz 0 (phase = 0 deg.) to 52 % of one period of waveform	50 to 100 % of one period of waveform 52 to 100 % of one period of waveform	Hi : 2.0 V :AWG710 1.0 V :AWG710B Low : 0.0V

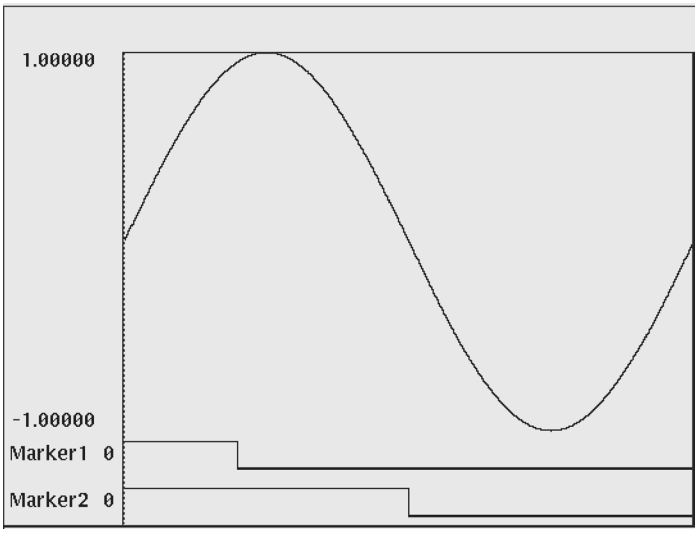


Figure 3-80: Marker pattern

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Frequency and Resolution

While operating in FG mode, the output frequency determines the number of data points used to generate the waveform data and the marker data for one period. The resolution of Pulse Duty cycle ratio and the width of Marker position corresponding to the number of data points are shown in the following table.

Table 3-56: Output Frequency and Waveform Length

Frequency	Number of Data Points	Duty Ratio Resolution (%)	Marker1 position[1]	Marker2 position[2]
1.000Hz to 400.0kHz	10000	0.1	2000	5000
400.1kHz to 4.000MHz	1000	0.1	200	500
4.001MHz to 20.00MHz	200	0.5	40	100
20.01MHz to 40.00MHz	100	1	20	50
40.01MHz to 80.0MHz	50	2	10	25
80.01MHz to 100.0MHz	40	2.5	8	20
100.1MHz to 160.0MHz	25	4	5	13[3]
160.01MHz to 200.0MHz	20	5	4	10
200.01MHz to 400.0MHz	10	10	2	5

1: 20% position of 1 waveform period
2: 50% position of 1 waveform period
3: 52% position of 1 waveform period because of number of data points.

Save/Restore Setup

You can save and restore the instrument output setup information on FG mode to a setup file. Setup file includes waveform type, marker signals and all the output setup parameters. Save/Restore operation is executed on the Save/Restore menu of the SETUP screen in AWG mode. A saved setup file contains the setting information on both AWG mode and each Extended Operation mode. Refer to The Save/Restore Menu on page 3-48.

Operation Flow

When the AWG710&AWG710B is in AWG mode, change to FG mode. Reference page 3-234.

1. Push **Sine**, **Triangle**, **Square**, **Ramp**, **Pulse** or **DC** (bottom) button to select the waveform.
2. Set the output parameters according to the waveform selected.
   - Duty is added to the side menu for Pulse mode.
   - Offset is only used for setup of DC level. Offset is selected on the DC side menu.

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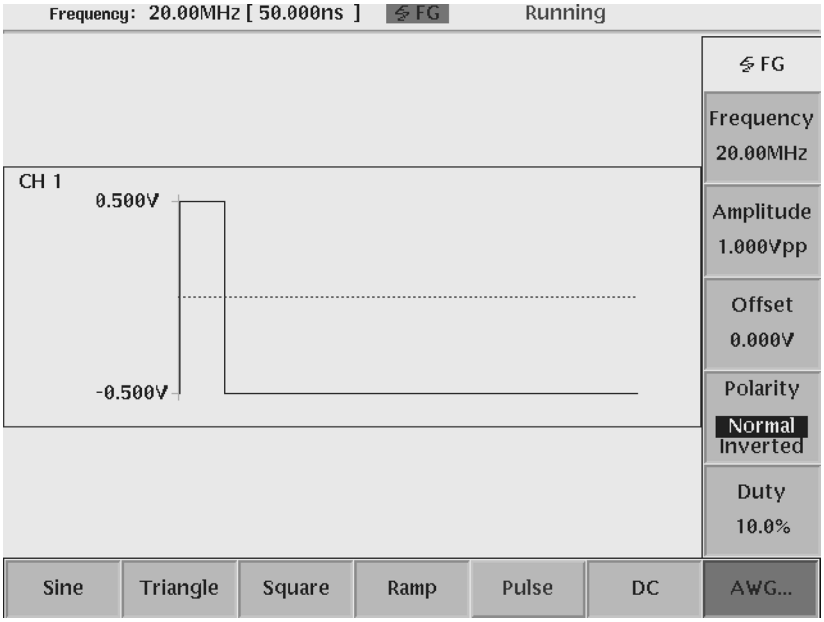


Figure 3-81: Pulse sub–side menu (except option 02)

3. Push the **RUN** (front) button to turn on the RUN LED. Usually, when it switches to FG mode from AWG mode, it automatically changes to the run state (the RUN LED is on).
4. Push the **CH1 OUT** button and **ALL MARKER OUT ON/OFF** button to output the signal that the corresponding output connector.

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Waveform Mixing Mode

The AWG710&AWG710B Arbitrary Waveform Generator provides the Waveform Mixing mode to create and output a mixed waveform. Waveform mixing generates the waveform which added the value for every point of two waveforms, A and B, at a rate of a mixing ratio.

Mixed signals are created and output using the following process:

- Select two waveform files to mix.
- Set the parameters about waveform mixing such as a mixing ratio, waveform length, etc.
- Set the output parameters such as frequency and amplitude.
- Turn the OUTPUT and ALL MARKER OUT ON/OFF buttons to ON.

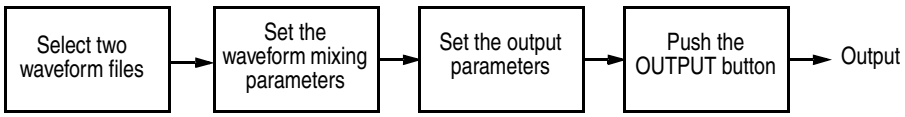


Figure 3-82: Outline flow for producing Mixed signal

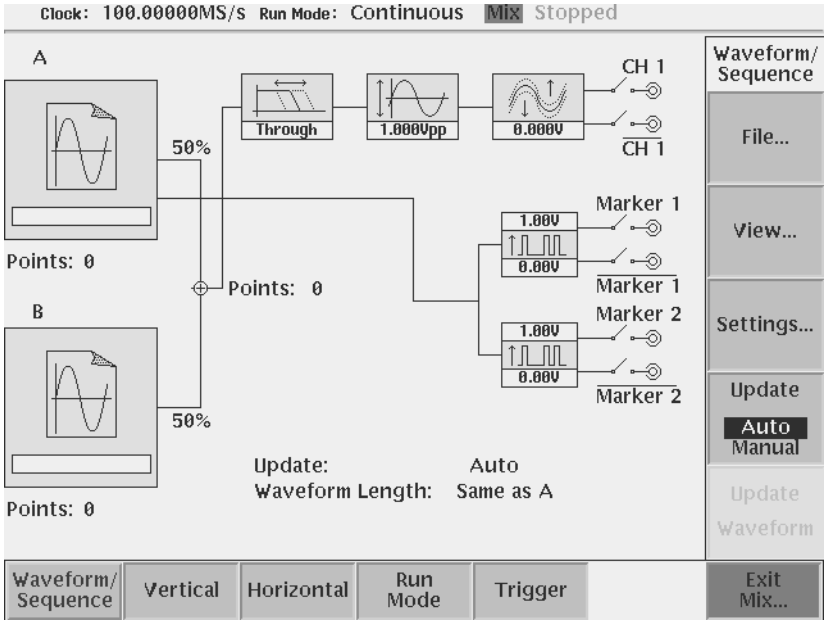


Figure 3-83: Waveform Mixing mode screen

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Change the generator mode

AWG mode to Waveform Mixing mode

The instrument initializes in the AWG mode when powered on.

Do the following to change the generator mode from AWG to Waveform Mixing:

1. Push **SETUP** (front–panel)→**Extended Operation** (bottom)→ **Waveform Mixing...** (side) button.

The instrument displays the Waveform Mixing mode screen.

Waveform Mixing mode to AWG mode

Do the following to change the generator mode from Waveform Mixing to AWG:

1. Push **Exit Mix...** (bottom) button.

The instrument returns to the AWG mode.

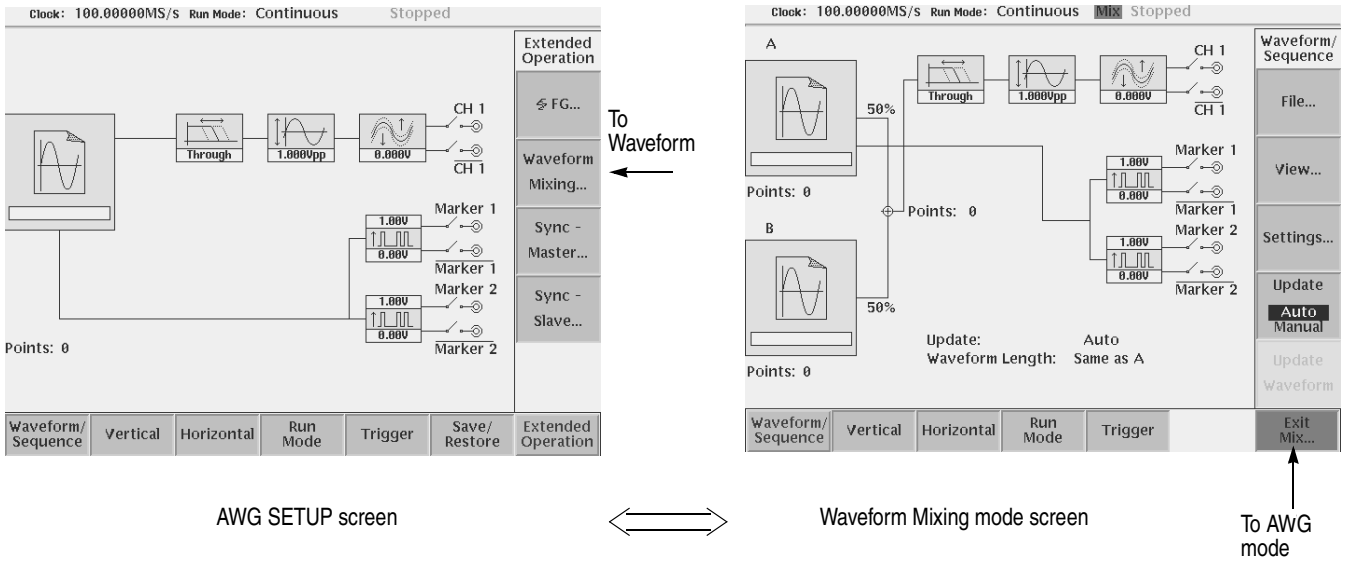


Figure 3-84: Change the generator mode

All bottom menus except the Waveform/Sequence menu are same as AWG mode, and the setting value of each parameter is also common.

NOTE. *When the instrument runs in Waveform Mixing mode, you cannot use Synchronous Operation mode or FG mode.*

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File... menu

Load A File...
Load B File...

Select two files, waveform A and waveform B, to mix. When the instrument enters Waveform Mixing mode, the waveform loaded in AWG mode is selected as Waveform A. Loading of the file in AWG mode sets data to the waveform memory for a waveform output. On the other hand, loading of the file in Waveform Mixing mode sets data to the work area for waveform mixing.

Please care about the following point, in case you select a waveform.

- A waveform file (*.wfm), a pattern file (*.pat), or a sequence file (*.seq) can be specified to be Waveform A and B. However, the sequence file containing a sub sequence cannot be specified.
- A pattern file and a pattern file included in the sequence file are treated as a waveform file. A eight bit pattern of each point is treated as the real number of the value of the range of -1 to +1.
- Although the combination of a waveform file and a pattern file is free, only combination with a sequence file is possible for a sequence file. If the illegal file type is specified, the file of another side will become blank.

Table 3-57: Combination of the file type

Waveform A	Waveform B	Descriptions
*.wfm or *.pat	*.wfm or *.pat	A pattern file is treated as a waveform file.
*.seq	*.seq	The number of lines needs to be the same. The sequence containing a sub sequence cannot be specified. As for a sequence control parameter, the value of the sequence file of Waveform A is used.

- Although the numbers of points of Waveform A and Waveform B may differ, the number of lines of a sequence file must be the same.
- The sequence control parameters (Repeat Count, Wait Trigger, Go to <N>, Logic Jump) of a sequence file of Waveform A become effective.
- Coincidence of the number of lines and the check of the number restrictions of points are performed at the time of loading of a file. It cannot load, when not meet conditions.
- The waveform file contains the clock rate value. When a file is loaded to Waveform A and B, the clock rate value of Waveform A is set as a clock rate value of AWG.

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- The file loaded to Waveforms A and B cannot be edited on the Edit screen.

Do the following steps to load a file:

1. Push **Waveform/Sequence** (bottom)→**File...** (side)→**Load A File...** or **Load B File...** (side)
2. Select a waveform file, pattern file or sequence from the file listing in the Select File dialog box that appears on the screen.
3. Push the **OK** side button.

Save Mixed Wfm... menu

A mixed result can be saved as waveform data (*.wfm). The information saved is the data and the clock rate of a mixed waveform.

The mixed waveform of the combination of a waveform file (*.wfm) and a pattern file (*.pat) is saved as a waveform file (*.wfm). The mixed waveform of the combination of a sequence file (*.seq) cannot be saved.

Not the value of present clock rate but the value included in the file by which it loaded to Waveform A is written in as a clock rate of a mixed waveform.

The mixed waveform saved is a waveform which it is loaded to a waveform memory and outputted now.When Manual is selected by Update menu, a saved waveform and a waveform based on a current setup of a SETUP screen may differ from each other. By pushing the Update Waveform button, each waveform will become the same. Refer to the Update on page 3-246

When you display a mixed waveform on the screen, save it as a waveform file and open it on the waveform editor.

Do the following steps to save a mixed waveform:

1. Push **Waveform/Sequence** (bottom)→**File...** (side)→ **Save Mixed Wfm As...** (side)

   Save Mixed Wfm As... button becomes effective when Waveforms A and B have been loaded.
2. An Input Filename dialog box is displayed. Specify a file name and a preservation directory and push the **OK** button.

Select a waveform file, pattern file or sequence from the file listing in the Select File dialog box that appears on the screen.

View... menu

While handling a file, you sometimes want to look at the content of a file to confirm the operation. View menu displays the view window and allows you to view a

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waveform or pattern file loaded in a waveform A or a waveform B. You cannot view files other than waveform or pattern in this function. When you display a mixed waveform on the screen, save it as a waveform file and open it on the waveform editor.

Do the following steps to display a loaded file:

1. Push **Waveform/Sequence** (bottom)→**View...** (side)→**View A** or **View B...** (side)

Waveform Mixing parameters

A mixed waveform is generated by the following formula to two specified waveforms.

Mixed.wfm = A.wfm * Ratio of A + B.wfm * Ratio of B

Ratio of A...
Ratio of B...

The ratio of Waveforms A and B is specified with a Ratio of A and Ratio of B button. The range of these parameters is as follows:

$0 \leq \text{Ratio of A (\%)} + \text{Ratio of B (\%)} \leq 100\ (\%)$

1. Push **Waveform/Sequence** (bottom)→**Setting...** (side)→**Ratio of A** or **Ratio of B** (side)
2. Use the general purpose knob, numeric buttons, or keyboard to change the ratio of Waveform A and B.

Marker

This button lets you select which marker of Waveforms A or B is used as a marker of a mixed waveform. The marker of the selected waveform is applied repeatedly and let it be the marker of a mixed waveform until it fills the waveform length of a mixed waveform.

1. Push **Waveform/Sequence** (bottom)→**Setting...** (side)→**Marker** (side)
2. Push the Marker side button to toggle between Same as A and Same as B.

Wfm Len

This button lets you specify the length of a mixed waveform. It is specified from the following:

- **Same as A**: The number of points of a mixed waveform is made the same as the number of points of Waveform A. When the number of points of Waveform

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B is small, it repeats until it becomes the number of points of a mixed waveform.

- **Same as B**: The number of points of a mixed waveform is made the same as the number of points of Waveform B. When the number of points of Waveform A is small, it repeats until it becomes the number of points of a mixed waveform.
- **LCM(A,B)**: The number of points of a mixed waveform is made into the least common multiple of the number of points of two waveforms.

1. Push **Waveform/Sequence** (bottom)→**Setting...** (side)→**Wfm Len**(side)
2. Use the general purpose knob or Wfm Len menu button to select the length of a mixed waveform.

Update

Loading of the file in AWG mode sets data to the waveform memory for a waveform output. On the other hand, loading of the file in Waveform Mixing mode sets data to the work area for waveform mixing. When data is set to Waveform A and Waveform B, preparation of waveform mixing will be completed. Based on parameters of waveform mixing, a mixed waveform is generated in a work area, and a mixed waveform is outputted in loading to a waveform memory.

With the Update button, you can specify the timing which generates a mixed waveform and is loaded to a waveform memory.

- **Auto**: When the file of Waveforms A or B is changed, or when a waveform mixing parameter is changed, a mixed waveform is regenerated and waveform data is loaded to a waveform memory.
- **Manual**: When the Update Waveform button (it will become effective if Manual is selected) is pushed, a mixed waveform data is regenerated and it is loaded to a waveform memory.

It takes much time in order to generate a large mixed waveform. By choosing Manual, it can prevent regenerating a mixed waveform at every parameter change.

1. Push **Waveform/Sequence** (bottom)→**Update** (side)
2. Push the **Update** side button to toggle between Auto and Manual.

When Manual is selected, the Update Waveform side button becomes effective.

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Save/Restore Setup

You can save and restore the instrument output setup parameters. The setup parameters on Extended Operation modes are saved together with the setting information on AWG mode at a setting file.

Save/Restore operation is executed on the Save/Restore menu of the SETUP screen in AWG mode. A saved setup file contains the setting information on both AWG mode and each Extended Operation mode. Refer to The Save/Restore Menu on page 3-48.

Operation Flow

When the AWG710&AWG710B is in AWG mode, change to Waveform Mixing mode. Reference page 3-242.

1. Push **Waveform/Sequence** (bottomless**...** (side)→**Load A File...** or **Load B File...** (side)
2. Push **Previous Menu** (side) to back to the Waveform/Sequence side menu.
3. Push **Update** (side) to select the Update mode.
   Usually, select Auto. When generating a large mixed waveform, select Manual.
4. Push **Setting...** (side) to specify the waveform mixing parameters.
   - **Ratio of A, Ratio of B**: Specify the ratio of Waveforms A and Waveform B.
   - **Marker**: Specify which marker is used as a marker of a mixed waveform.
   - **Wfm Len**: Specify the length of the mixed waveform.
5. When Manual is selected in the Update menu, mixed waveform is updated when **Update Waveform** (side) button is pushed.
6. When Manual is chosen in Update mode, change of a parameter will be reflected if Update Waveform is pushed.
7. Set each item of Vertical, Horizontal, Run Mode, and the Trigger menu like the time of AWG mode.
8. Set each parameter of the Vertical, Horizontal, Run Mode, and Trigger menu is set up like the time of the usual AWG mode.
9. Push the **RUN** (front) button to turn on the RUN LED.
10. Push the **CH1 OUT** button and **ALL MARKER OUT ON/OFF** button to output the signal that the corresponding output connector.

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Synchronous Operation Mode (AWG710B only)

Synchronous Operation is a feature that allows you to use two channels of signal by operating two AWG710B. A word synchronous called here means that two units of the AWG710B operate with the same clock and that start and stop of output signals of two units are corresponding.

A unit that controls the overall system is called Master, and a unit that is used for an additional channel is called Slave. In the Synchronous Operation mode, the master and slave should be connected directly for the Clock and Trigger signals, because the timing is critical. For other signals, the master controls the slave through a LAN. Although loading of a waveform file and the setting parameter of the Vertical menu are performed to Master and Slave each, control of other Slave is performed from Master via LAN.

The remote command via LAN can be used also during synchronous operation.

Two units of synchronous operations are performed as follows:

- Connect two LAN cables, four Clock signal cables and four Trigger signal cables.
- One unit is set as Slave and one more unit is set as Master.
- Connect the Master and the Slave via LAN.
- Load the waveform files to the Master and the Slave.
- Set the output parameters such as frequency and amplitude
- Master and Slave are connected via LAN.
- Turn the OUTPUT and ALL MARKER OUT ON/OFF buttons to ON.

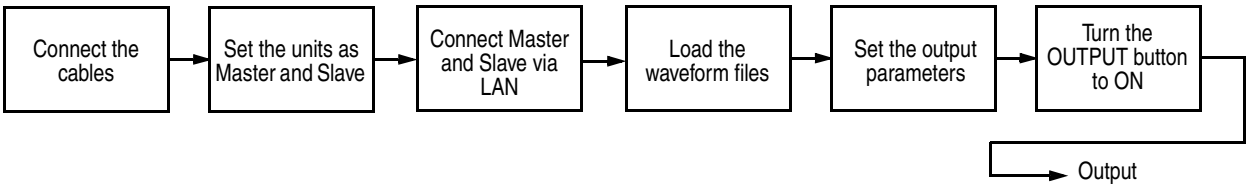


Figure 3-85: Outline flow for producing Synchronous operation

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restrictions

There are the following restrictions in synchronous operation mode operation.

- The same model and the same firmware version should be used for Synchronous Operation.
- When the instruments run in Synchronous Operation mode, you cannot use FG mode or Waveform Mixing mode.
- The Gated mode in Run mode cannot be used. An event jump cannot be used although Enhanced mode can be used.
- Waveform length needs to be in agreement Although waveforms may differ in the waveform file loaded to Master and Slave, the number of points of waveform files must be the same.
- The sequence files loaded to Master and Slave needs to be completely the same. However, the waveforms specified to be each sequence line may differ, as long as the waveform length is the same.
- The file loaded to the waveform memory cannot be edited or Quick edited.
- Another waveform file cannot be loaded during output operation (RUN LED under lighting).

Connecting the cables

LAN cable

In Synchronous Operation mode, the Master control the Slave through a LAN. Master and Slave are connected to a network using a LAN cable. You need to connect the LAN cables before you power on the instruments.

Cables for Clock and Trigger

To synchronize the clock and jump timing on the overall system, connect the two types of signals, Sync Clock and Sync Trigger. It is necessary to supply the same signals to Master and Slave from Master. The cable to be used must conform to the requirements of length and characteristics. Use the specified 50 cm 50 Ω SMA cable (P/N: 174-1427-00 made by Tektronix).

Connect the eight SMA cables as shown in Figure 3-86 on page 3-251 . The label C of a connection figure expresses the clock and T expresses the trigger signal.

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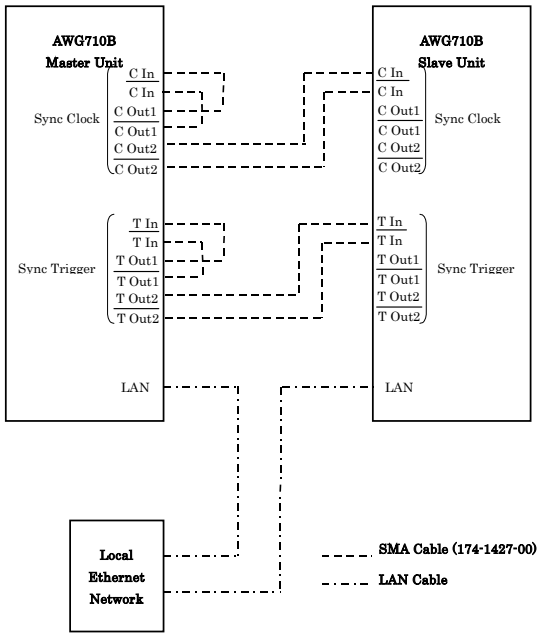


Figure 3-86: Synchronous Operation cable connection

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Change the generator mode

AWG mode to Synchronous Operation mode

The instrument initializes in the AWG mode when powered on.

Do the following to change the generator mode from AWG to Synchronous Operation:

1. Push **SETUP** (front–panel)→**Extended Operation** (bottom)→ **Sync - Master...** or **Sync - Slave...** (side) button.

The instrument displays the Synchronous Operation mode screen.

Synchronous Operation mode to AWG mode

Do the following to change the generator mode from Synchronous Operation to AWG:

1. Push **Exit Sync...** (bottom) button.

The instrument returns to the AWG mode.

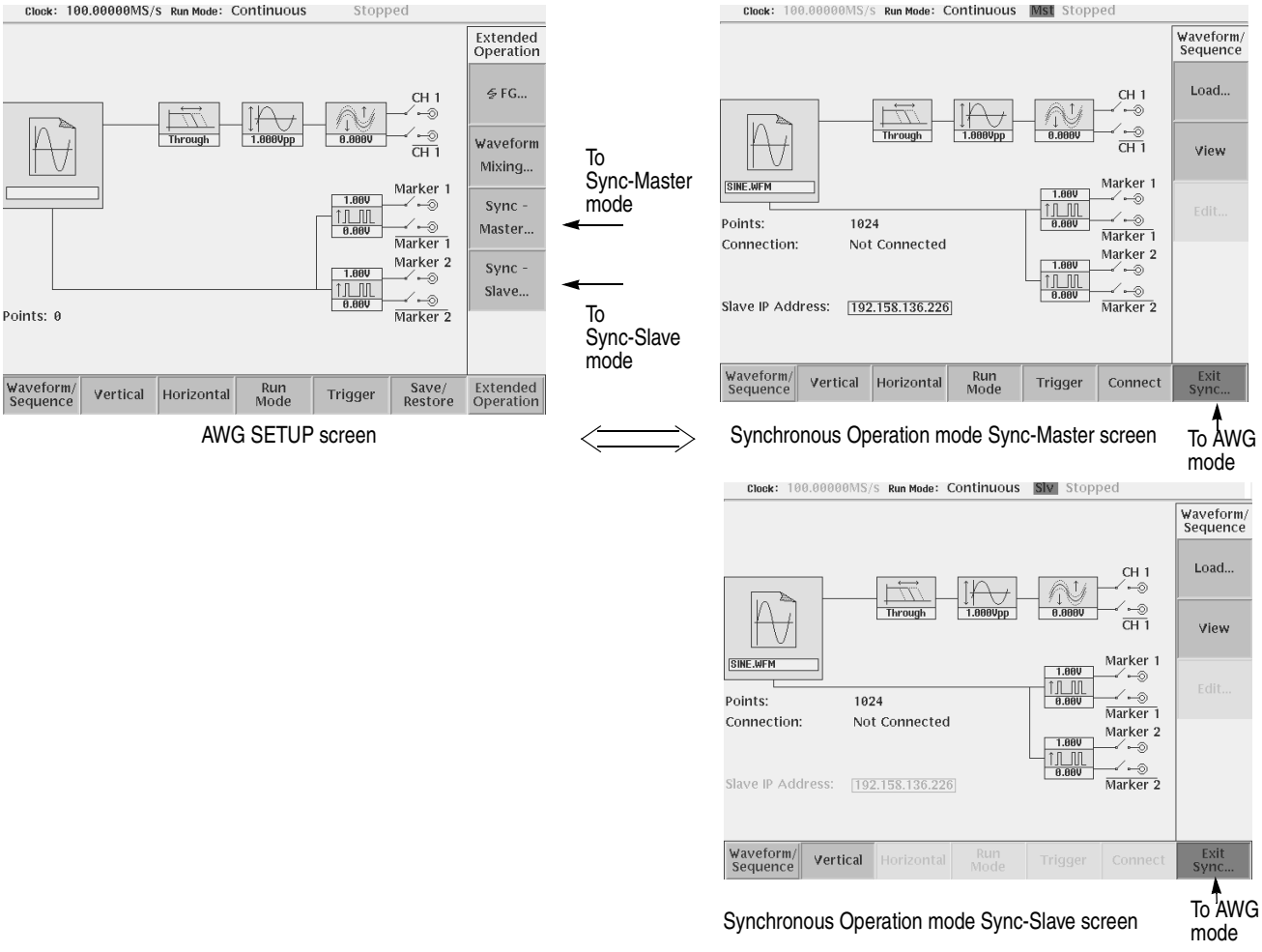
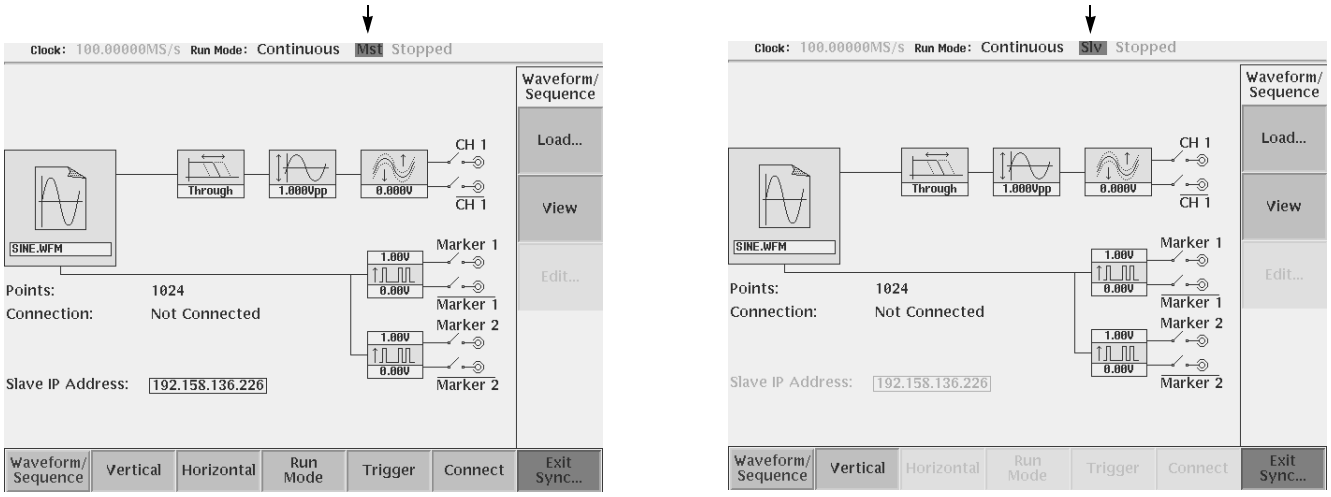


Figure 3-87: Change the generator mode

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Setup screen



Synchronous Operation mode Sync-Master screen

Synchronous Operation mode Sync-Slave screen

Figure 3-88: Synchronous Operation mode screen

- **Status area**: Mst or Slv mark is displayed and it indicates that the instrument is Synchronous Operation mode.
- **Connection**: The connection state of Master and Slave is displayed. When connecting, the IP address of a partner's unit is displayed. When not connecting, it is displayed as Not Connected.
- **Slave IP Address**: The IP address of Slave set by Master is displayed.

Vertical, Horizontal, Run Mode, and the Trigger menu of the SETUP screen in Sync-Master mode are as same as AWG mode, and the same setting value is used. The Connect bottom menu performs a setup about synchronous operation.

On the SETUP screen in Sync-Slave mode, only Waveform/Sequence and the Vertical menu are effective. The setting item of Horizontal, Run Mode, and Trigger menu is controlled from Master.

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Table 3-58: Difference between AWG mode and synchronous operation mode

Bottom menu	Sync-Master	Sync-Slave
Waveform /Sequence	Another waveform file cannot be loaded during output operation (RUN LED under lighting). The loaded file cannot be edited.	Another waveform file cannot be loaded during output operation (RUN LED under lighting). The loaded file cannot be edited.
Vertical		
Horizontal		It controls by Master.
Run Mode	Gated mode cannot be used.	It controls by Master.
Trigger		It controls by Master.

Setting a Slave IP address

The IP address of Slave is registered into Master with the **Edit Slave IP Address** menu.

1. Push **UTILITY** (front-panel)→**Comm** (bottom) button of the AWG710B used as slave
2. Check and write the IP address of slave.
3. Push **Connect** (bottom)→**Edit Slave IP Address...**(side) button of the master AWG710B.
4. The Slave IP Address dialog box appears. Enter the IP address of the slave AWG710B.
5. Push the **OK** side button.

Testing the Network Connection

Complete the physical connection and settings, using the **Execute Ping...** menu verify that the slave AWG710B can be recognized correctly. The usage is the same as Execute Ping of the Comm bottom menu of a UTILITY screen. Refer to the Testing the Network Connection on page 3-164 .

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Connection with Slave

Connection and disconnection with Slave are performed by Master using the **Connect to Slave** and **Disconnect** menu.

1. Push **SETUP** (front-panel)→**Connect**(bottom) →**Connect to Slave** (side) button to connect to the slave AWG710B.
2. Push **SETUP** (front-panel)→**Connect**(bottom) →**Disconnect** (side) button to disconnect to the slave AWG710B.

In the following cases, the connection between Master and Slave is canceled automatically.

- The LAN cable is unplugged from the connector.
- The power of Slave was turned off.
- Master or Slave was changed from Synchronous Operation mode.
- When executing Diagnostic or Calibration of the UTILITY menu.

Error messages on connection

When making connection with Slave in Synchronous Operation mode, the AWG710B is also performing Trigger Timing CAL automatically.

The following error/warning messages may be displayed during operation in Synchronous Operation mode.

Table 3-59: Error/Warning messages

Message	Description
Gated is not available in Synchronous Operation.Run Mode will be changed to Continuous.	It is the warning message which comes out when it is going to go into Sync-Master, where Gated is specified by Run Mode. Ruined switches to Continuous.
External Clock Source or External Clock Reference is not available in Synchronous Operation - Slave. Clock Source and Clock Reference will be changed to Internal	It is the warning message which comes out when it is going to go into Sync-Slave, where External is specified by ClockSource or by ClockReference. As for the Slave itself, Clock and Reference Clock operate in the state of Internal.
Connection will be lost.	It is displayed, when connection between Master and Slave is established and it is going to perform Calibration/Diagnostics of the UTILITY menu.

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Table 3-59: Error/Warning messages (cont.)

Message	Description
Connection \failed. Verify the instrument settings: - Network cable is properly connected. -Slave IP Address entered correctly. -Slave unit is configured as Sync-Slave. If the problem still exists, power the instrument off and then back on, for Master and Slave.	It is displayed when connection with Slave is not made normally. The following cause can be considered. ■ It was going to connect with an instrument other than AWG710B. ■ An instrument which it is going to connect is not Sync-Slave mode. ■ Although the AWG710B which it is going to connect is Sync-Slave mode, it has already connected with other AWG710B. ■ The IP address of slave instrument is incorrect. ■ Slave AWG710B has not started yet. ■ The LAN cable is not connected. ■ The LAN cable was connected after the AWG710B was powered on.
Synchronous Operation is not supported between different models of AWG.	It is displayed when it is going to connect with an instrument other than AWG710B.
Trigger Timing Calibration failed.(Master) / (Slave) Check SMA cable connections.	It is the error which takes place at the time of a connection start with Slave, or a Trigger Timing CAL start. It is displayed when the SMA cable of Master or Slave is not connected correctly.
Trigger Timing Calibration failed. (Communication)	It is displayed when communication with slave cannot be taken with network obstacles (the cable unplugged) during calibration execution.

Trigger Timing Calibration

This calibration makes the skew to a trigger signal regularity. When making connection between Master and Slave, AWG710B is always performing this calibration automatically.When temperature change arises while in use, it can perform if needed. It can perform only where connection with Slave is established.

1. Connect the LAN cables and SMA cables.
2. Power the two AWG710B on, and set the each AWG710B as Master and Slave.
3. Push **Connect** (bottom) →**Connect to Slave** (side) button to establish connection with Slave. The **Execute Trigger Timing Calibration** (side) button will become effective if connection is established.
4. Push **Connect** (bottom) →**Execute Trigger Timing Calibration** (side) button to execute the trigger timing calibration.

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Save/Restore Setup

You can save and restore the instrument output setup parameters. The setup parameters on Extended Operation modes are saved together with the setting information on AWG mode at a setting file.

Save/Restore operation is executed on the Save/Restore menu of the SETUP screen in AWG mode. A saved setup file contains the setting information on both AWG mode and each Extended Operation mode. Refer to The Save/Restore Menu on page 3-48.

Operation Flow

Two AWG710Bs are set as Sync-Master and Sync-Slave in the following procedure, and synchronous operation is performed.

1. In the power off state, connect two LAN cables, four clock signal cables and four trigger signal cables
2. Push the front panel On/Standby switch to power on the instrument.
3. Check and write the IP address of slave
4. Push **SETUP** (front–panel)→**Extended Operation** (bottom)→ **Sync - Slave...** (side) button of the slave AWG710B.
5. Push **SETUP** (front–panel)→**Extended Operation** (bottom)→ **Sync - Master...** (side) button of the master AWG710B.
6. Push **Connect** (bottom)→**Edit Slave IP Address...**(side) button of the master AWG710B to register the IP address of the slave AWG710B.
7. If required, push **Execute Ping...** (side) button to check that Slave can be recognized on a network.
8. Push **Connect to Slave** (side) button to connect to the slave AWG710B.
9. Specify the files of the waveform to output and set the parameters of the Vertical menu by Master and Slave.
10. The setting parameters about outputs, such as the Horizontal menu, are performed by Master.
11. Push the **CH1 OUT** button and **ALL MARKER OUT ON/OFF** button to output the signal that the corresponding output connector.
12. Push the **RUN** (front) button of the master AWG710B to start operation.

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Appendices

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Appendix A: Specifications (AWG710B)

This section contains the AWG710B Arbitrary Waveform Generator specifications. All specifications are guaranteed unless labeled “typical”. Typical specifications are provided for your convenience but are not guaranteed.

Specifications that are marked with the ✓ symbol in the column Characteristics are checked in *Appendix B: Performance Verification* and the page number referenced to the corresponding performance verification procedures can be found in the column PV reference page.

The characteristics in the specifications are listed in tables that are divided into categories. In these tables, the subcategories may also appear in boldface under the column Characteristics.

Performance Conditions

The performance limits in this specification are valid with these conditions:

- The AWG710B Arbitrary Waveform Generator must have been calibrated/adjusted at an ambient temperature between +20° C and +30° C.
- The AWG710B Arbitrary Waveform Generator must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.
- The AWG710B Arbitrary Waveform Generator must have had a warm–up period of at least 20 minutes.
- The AWG710B Arbitrary Waveform Generator must be operating at an ambient temperature between +10° C and +40° C.

Warranted characteristics are described in terms of quantifiable performance limits which are warranted.

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Electrical Specification

Table A-1: Operation modes

Characteristics	Description
Continuous	Waveform is continuously output in this mode. When a sequence is defined, waveforms are sequentially or repeatedly output in the order defined by the sequence. The extended sequence functions such as trigger input, event jump, and so on are neglected in this mode.
Triggered	Waveform is output only once when a trigger event is created. A trigger signal is created by the external trigger input signal, GPIB trigger command, and/or pressing the front–panel FORCE TRIGGER button. The extended sequence functions such as trigger input, event jump, and so on are neglected in this mode.
Gated	The waveform is output in the same way as in the continuous mode only when the gate is opened. The gate is opened by the gated signal. Note that the output is made from the top of the first waveform for every gate period. The clock signal continuously outputs from the connector outside the gate period.
Enhanced	The waveforms are sequentially or repeatedly output according to the procedures defined in the sequence. All extended functions such as trigger input, event jump, and so on are effective and waveforms are controlled for output by this functions in this mode.

Table A-2: Extended Operation

Characteristics	Description
FG operation	This mode provides user-friendliness like the conventional function generator. The output waveforms are Sine, Triangle, Square, Ramp, Pulse and DC waveform. AWG710B is in AWG mode when this mode is not selected.
Waveform Mixing operation	This mode provides the function for mixing two-signals digitally.
Synchronous Master operation	This mode provides the setup for using as a Master instrument on Synchronous Operaion.
Synchronous Slave operation	This mode provides the setup for using as a Slave instrument on Synchronous Operation.

Table A-3: Arbitrary waveforms

Characteristics	Description
Waveform memory	Memory length: 32 400 000 words (8 bits/1 word)
Op.01	Memory length: 64 800 000 words (8 bits/1 word)
Marker memory	Memory length: 132 400 000 words (2 markers × 1 bit / 1 word)
Op.01	Memory length: 64 800 000 words (2 markers × 1 bit / 1 word)
Sequence memory	1 to 8000 steps

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Table A-3: Arbitrary waveforms

Characteristics	Description
Sequence counter	1 to 65 536 and Infinite
Waveform data points	Multiple of 4 in the range from 960 to 32 400 000 points
Op.01	Multiple of 4 in the range from 960 to 64 800 000 points
Data storage	
Hard disk	≥20 G bytes
Floppy disk	1.44 M bytes

Table A-4: Clock generator

Characteristics	Description	PV reference page
Sampling frequency	50.000 000 kHz/s to 4.200 000 0 GHz/s	
Resolution	8 digits	
Internal clock [1]		
✓ Frequency accuracy	± 1 ppm (10 °C to 40 °C), during 1 year after calibration	Page B-48
Phase noise at VCO output, Typical	-65 dBc / Hz (4.2 GS/s with 10 kHz offset) -96 dBc / Hz (4.2 GS/s with 100 kHz offset)	

[1] **The internal reference oscillator is used.**

Table A-5: Internal trigger generator

Characteristics	Description	PV reference page
Internal trigger rate [2]		
Accuracy	± 0.1 %	
Range	1.0 µs to 10.0 s	
Resolution	3 digits, minimum 0.1 µs	

[2] **The internal reference oscillator is used.**

Table A-6: Main output

Characteristics [3]	Description	PV reference page
Output connector	front–panel SMA connectors	
Output signal	Complemental; CH1 and $\overline{\text{CH1}}$	
DA converter		
Resolution	8 bits	

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Table A-6: Main output (cont.)

Characteristics [3]	Description	PV reference page
Differential nonlinearity	Within ± 1/2 LSB	
Integral nonlinearity	Within ± 1 LSB	
Output impedance	50 Ω	
Normal out (except option 02)		
Output voltage	-1.5 V to +1.5 V, into a 50 Ω load	
Amplitude		
Range	20 mV_{p-p} to 2 V_{p-p}, into a 50 Ω load	
Resolution	1 mV	
✓ DC accuracy	± (2.0 % of amplitude + 2 mV), offset: 0 V	Page B-19
Offset		
Range	-0.5 V to 0.5 V, into a 50 Ω load	
Resolution	1 mV	
✓Accuracy	± 1.5 % of offset ± 10 mV, (20 mV amplitude, waveform data: 0)	Page B-19
Pulse response	(Waveform data: -1 and 1, offset: 0 V, and filter: through, Clock: 1.0 GS/s)	
✓Rise time (10 % to 90 %)	≤ 480 ps (amplitude = 1.0 V_{p-p}, calculated value ≥ 729 MHz)	Page B-31
✓Fall time (10 % to 90 %)	≤ 480 ps (amplitude = 1.0 V_{p-p}, calculated value ≥ 729 MHz)	
Aberration, Typical	± 6 % (amplitude + 1.0 V_{p-p}, using 6 GHz bandwidth oscilloscope)	
Flatness, Typical	± 3 % (after 20 ns from rise or fall edges)	
Sinewave characteristics	(Clock: 4.2 GS/s, waveform points: 32, Signal frequency: 131.25 MHz, amplitude: 1.0 V, offset: 0 V, filter: through)	
Harmonics	≤ -40 dBc (DC to 1000 MHz)	
Noise	≤ -50 dBc (DC to 1000 MHz)	
Phase Noise, Typical	≤ -85 dBc / Hz (at 10 kHz offset)	
Direct DA out (except option 02)		
Amplitude		
Range	20 mV_{p-p} to 1 V_{p-p}, into a 50 Ω load	
✓DC Accuracy	± (2 % of Amplitude + 2 mV)	Page B-23
Resolution	1 mV	
✓ DC offset accuracy	0 V ± 10 mV, (20 mV amplitude, waveform data: 0)	Page B-23
✓ Pulse response	(Waveform data: -1 and 1, at 0.5 V_{p-p})	Page B-25
Rise time (10 % to 90 %)	≤ 280 ps (calculated value ≥ 1.25 GHz)	
Fall time (10 % to 90 %)	≤ 280 ps (calculated value ≥ 1.25 GHz)	
Extended Bandwidth output (option 02)		
Amplitude		

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Table A-6: Main output (cont.)

Characteristics [3]	Description	PV reference page
Range	500 mV_{p-p} to 1 V_{p-p}, into a 50 Ω load	
✓DC Accuracy	± (2 % of Amplitude + 2 mV)	Page B-27
Resolution	1 mV	
✓ DC offset accuracy	0 V ± 10 mV, (500 mV amplitude, waveform data: 0)	Page B-27
✓ Pulse response	(Waveform data: -1 and 1, at 1 V_{p-p})	Page B-29
Rise time (10 % to 90 %)	≤ 175 ps (calculated value ≥ 2 GHz)	
Fall time (10 % to 90 %)	≤ 175 ps (calculated value ≥ 2 GHz)	

[3] **The characteristics are specified at the end of the SMA cable (174–1427–00) except for DC accuracy.**

Table A-7: Filter (except option 02)

Characteristics	Description	
Type	Bessel low pass filter, 200 MHz,100 MHz, 50 MHz, and 20 MHz	
Rise time (10 % to 90 %), Typical	20 MHz 50 MHz 100 MHz 200 MHz	17 ns 7 ns 3.7 ns 2 ns
Group delay, Typical	20 MHz 50 MHz 100 MHz 200 MHz	18 ns 8 ns 4.7 ns 3 ns

Table A-8: Auxiliary outputs

Characteristics	Description	PV reference page
Marker [4]		
Number of markers	2 (Complementary). Marker1, $\overline{\text{Marker1}}$, Marker2, and $\overline{\text{Marker2}}$	
Connector	Front panel SMA connectors	
High Level (VoH) Range	-1.00 V to +2.45 V, into a 50 Ω load Refer to Figure A-8 on page A-16	
Low Level (VoL) Range	-2.00 V to +2.40 V, into a 50 Ω load Refer to Figure A-8 on page A-16	
Amplitude (VoH - VoL) Range	0.05 V_{p-p}, to 1.25 V_{p-p} into a 50 Ω load	
Resolution	50 mV	
✓ DC Accuracy	± 0.1 V ± 5 % of setting, into a 50 Ω load	Page B-50
Maximum Output Current	± 80 mA	

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Table A-8: Auxiliary outputs (cont.)

Characteristics	Description	PV reference page
Rise and fall times (20 % to 80 %), Typical	<130 ps (High: 1.0 V, Lo: 0 V, into a 50 Ω load)	
Period jitter, Typical	Measured by TDS6604 with TDSJIT3. Refer to Table A-9.	
Cycle to Cycle jitter, Typical	Measured by TDS6604 with TDSJIT3. Refer to Table A-10.	
Skew, Typical	<20 ps	
Delay between Analog Output and Marker Output, Typical	Maker level: 1 V_{p-p} (High: +1.0 V, Low: 0 V), Analog Output Amplitude: 1 V_{p-p} , Offset: 0 V, Filter: Through, Refer to Figure A-1 on page A-9 2.4 ns (Normal Output, Offset: 0 V, Filter: Through) -1.0 ns (Direct Output) 2.0 ns (Option 02)	
VCO output		
Connector	Rear panel SMA connector	
Amplitude	0.4V_{p-p} into a 50 Ω load 0.8 V_{p-p} max. open circuit	
Impedance	50 Ω, AC coupling	
Period jitter, Typical	Measured by TDS6604 with options 1M and HD and TDSJIT1. Refer to Table A-11.	
Cycle to Cycle jitter, Typical	Measured by TDS6604 with options 1M and HD and TDSJIT1. Refer to Table A-12.	
Connector	Rear panel SMA connector	
10 MHz Reference clock out		
Amplitude, Typical	1.2 $V_{p–p}$, into a 50 Ω load, Max 2.5 $V_{p–p}$, open circuit	
Impedance	50 Ω, AC coupling	
Connector	Rear panel BNC connector	
C Out 1, C Out 2 out	This signal is used for only Synchronous operation between Master and Slave unit.	
Connector	Rear panel SMA connector	
Input Signal Type	Complementary	
T Out 1, T Out 2 out	This signal is used for only Synchronous operation between Master and Slave unit.	
Connector	Rear panel SMA connector	
Input Signal Type	Complementary	
Display Monitor out		
Format	VGA	
Connector	15 pin, D-SUB, Rear panel	
Level	ECL	

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Table A-8: Auxiliary outputs (cont.)

Characteristics	Description	PV reference page

[4] **The characteristics are specified at the end of the SMA cable (012–1565–00).**

Table A-9: Marker output Period Jitter

Clock frequency	4.2 GS/s		2.1 GS/s		1.05 GS/s	
Measurement	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
Marker output	2.0 ps	15 ps	2.0 ps	15 ps	2.0 ps	15 ps
Note.Period Jitter is measured with Clock Pattern (01010101.....)						

Table A-10: Marker output Cycle to Cycle Jitter

Clock frequency	4.2 GS/s		2.1 GS/s		1.05 GS/s	
Measurement	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
Marker output	3.4 ps	25 ps	3.4 ps	25 ps	3.7 ps	26 ps
Note.Cycle to Cycle Jitter is measured with Clock Pattern (01010101.....)						

Table A-11: VCO output Period Jitter

Clock frequency	4.2 GS/s		2.1 GS/s		1.05 GS/s	
Measurement	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
VCO output	1.4 ps	10 ps	1.4 ps	10 ps	1.4 ps	10 ps

Table A-12: VCO output Cycle to Cycle Jitter

Clock frequency	4.2 GS/s		2.1 GS/s		1.05 GS/s	
Measurement	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
VCO output	2.4 ps	16ps	2.4 ps	16 ps	2.4 ps	16 ps

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Table A-13: Auxiliary inputs

Characteristics	Description	PV reference page
Trigger input [5]		
Connector	Rear panel BNC connector	
Impedance	1 kΩ or 50 Ω	
Polarity (Trigger mode)/ Slope (Gated mode)	POS (positive) or NEG (negative)	
Input voltage range	± 10 V, into a 1 kΩ load ± 5 V, into a 50 Ω load	
Threshold		
Level	-5.0 V to 5.0 V	
Resolution	0.1 V	
Triggered mode	See Figure A-1 on page A-9	
Minimum pulse width	10 ns, 0.2 V amplitude	
Trigger hold off time	≤ 109.5 clocks + 500 ns ; Single operation ≤ 109.5 clocks + 700 ns ; Synchronous operation	
Delay to analog out, Typical	275.5clocks + 17 ns (Output: Norm, Filter: Through)	
Gated mode	See Figure A-2 on page A-10	
Minimum pulse width	1152 clocks + 10 ns, 0.2 V amplitude	
Gate hold off time	≤ 1920 clock + 20 ns (The time interval between the last gate off point and the next gaate on point)	
Delay to analog out, Typical	(1355 to 1563.5) clocks + 9 ns (Output: Norm, Filter: Through)	

[5] **The characteristics are specified at the end of the BNC cable (012–0482–00).**

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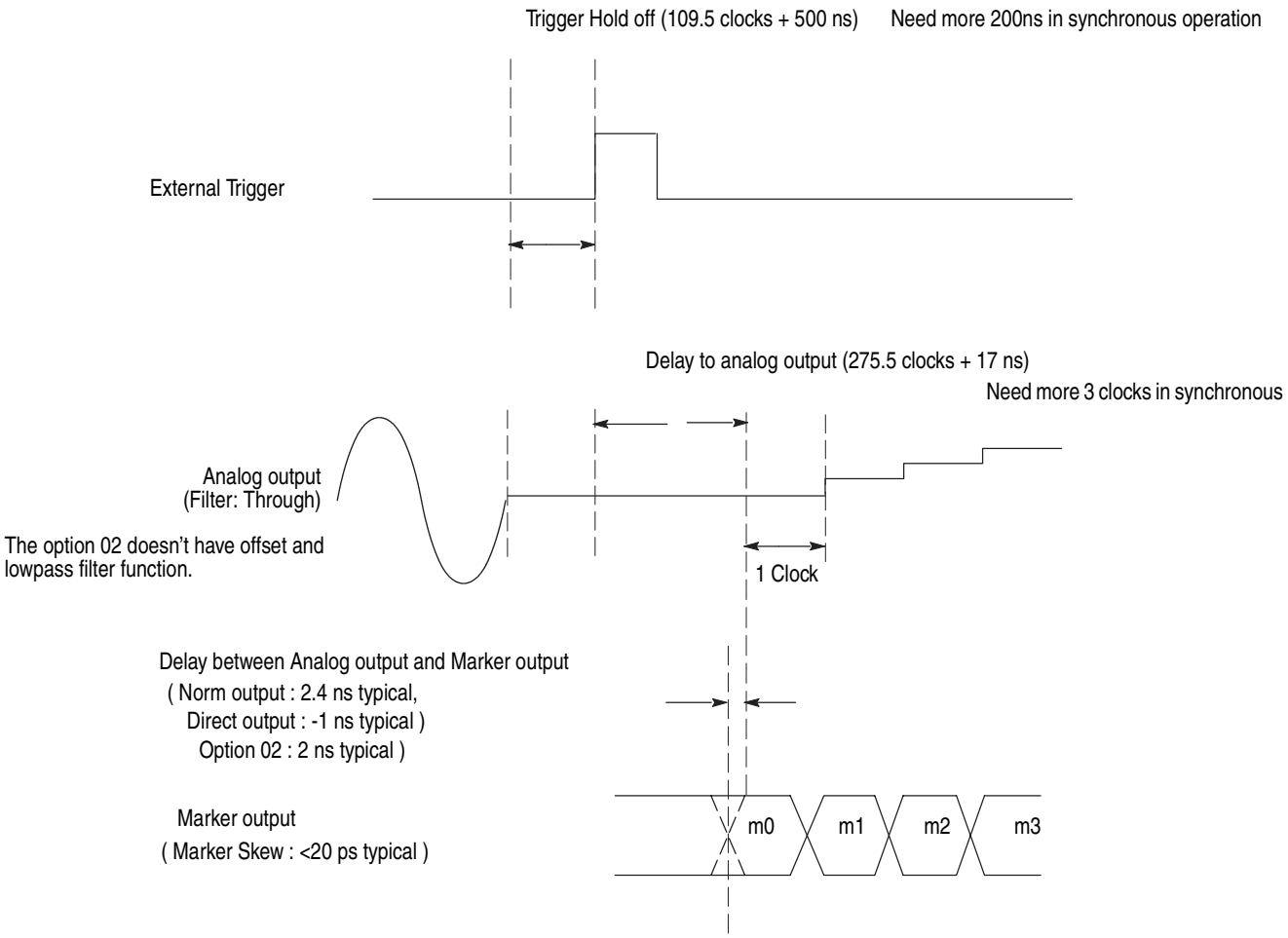
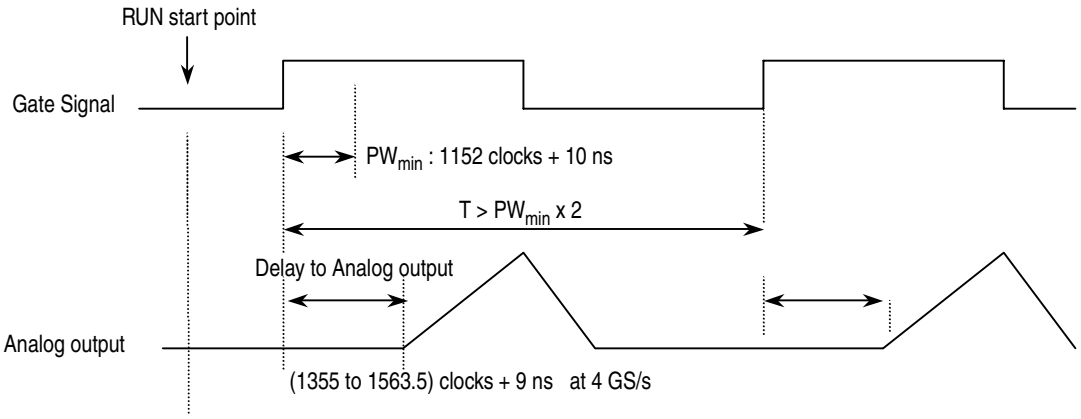


Figure A-1: Signal Timing

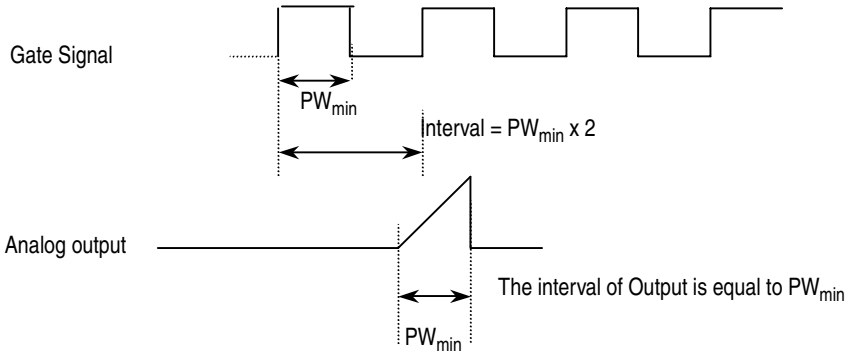
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1. After RUN starting, Gate signal is input

1-1. The interval of Gate signal is longer than PW_{min} (Minimum Pulse Width) x 2

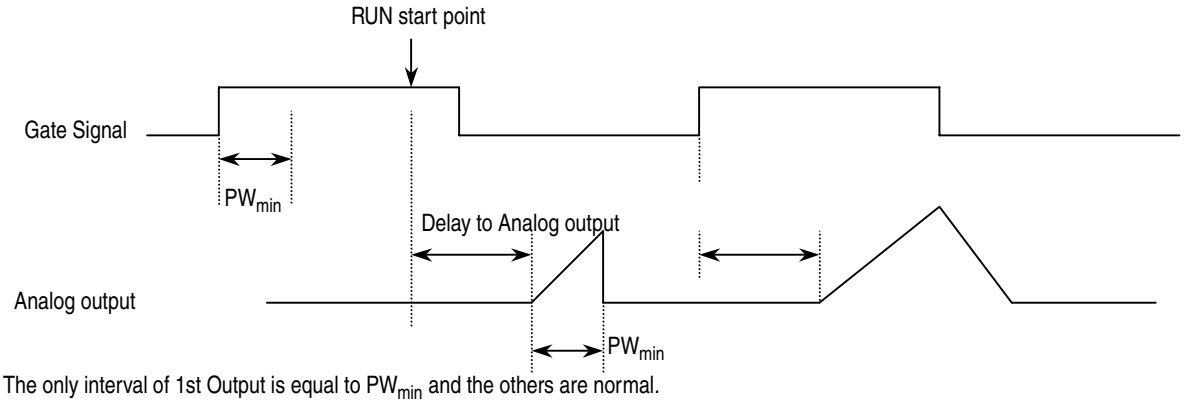


1-2. The interval of Gate signal is equal to PW_{min} (Minimum Pulse Width) x 2



2. Before RUN starting, Gate signal is input

2-1. The interval of Gate signal is longer than PW_{min} (Minimum Pulse Width) x 2



The only interval of 1st Output is equal to PW_{min} and the others are normal.

2-2. The interval of Gate signal is equal to PW_{min} (Minimum Pulse Width) x 2

As above 1-2, the interval of Analog Output is equal to PW_{min} .

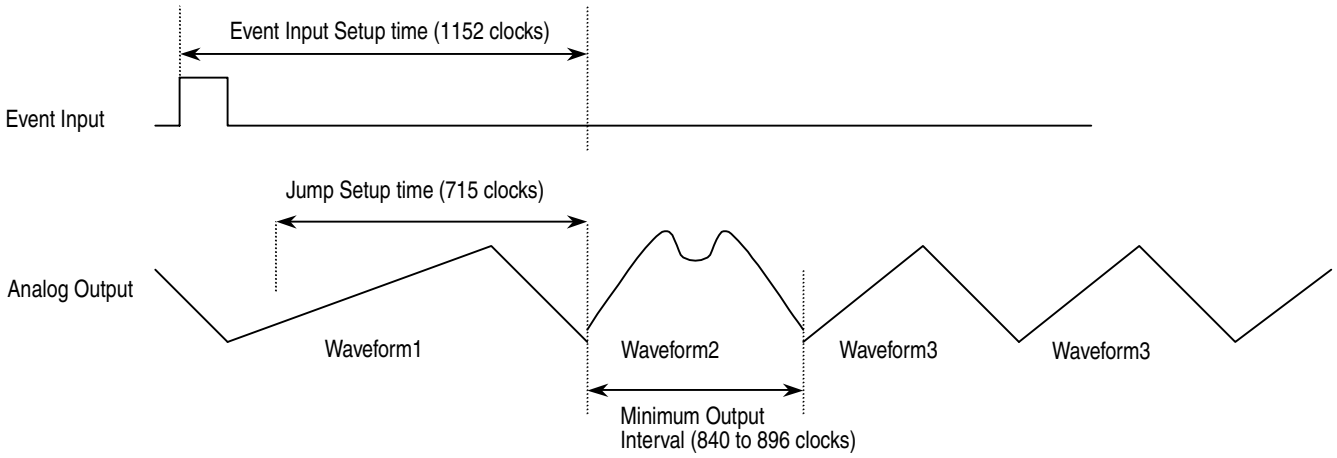
Figure A-2: Gated Mode

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1. Sequence 1

Line No.	Waveform Name	Wait for Trigger	Jump to
n:	Waveform1	Off	m (Waveform3)
n+1:	Waveform2	Off	m+1 (Waveform4)
m:	Waveform3	Off	--
m+1:	Waveform4	Off	--

1-1.



1-2

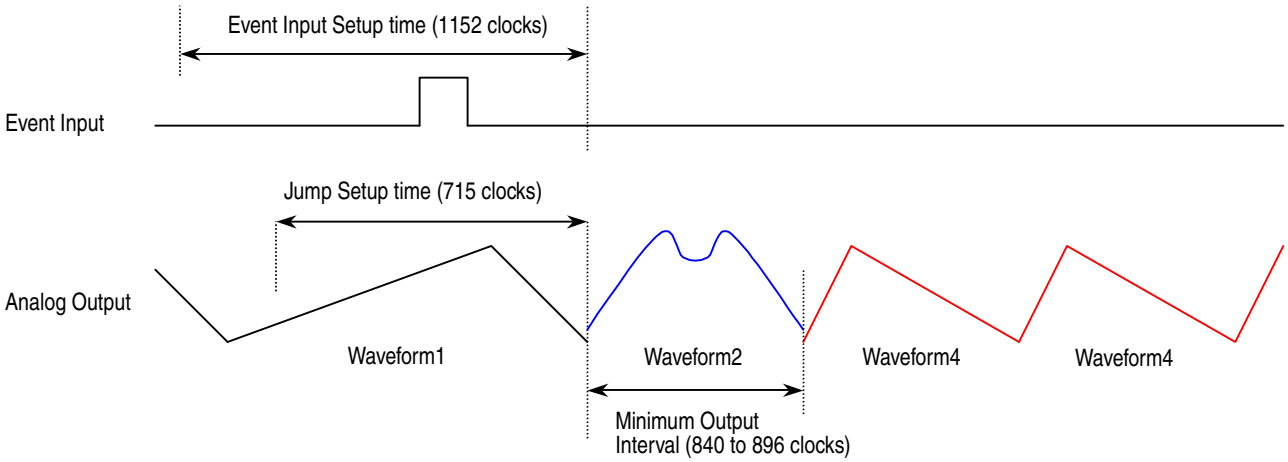


Figure A-3: Enhanced mode

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2. Sequence 2

Line No.	Waveform Name	Wait for Trigger	Jump to
n:	Waveform1	Off	m (Waveform3)
n+1:	Waveform2	Off	m+1 (Waveform4)
m:	Waveform3	On	--
m+1:	Waveform4	On	--

2-1.

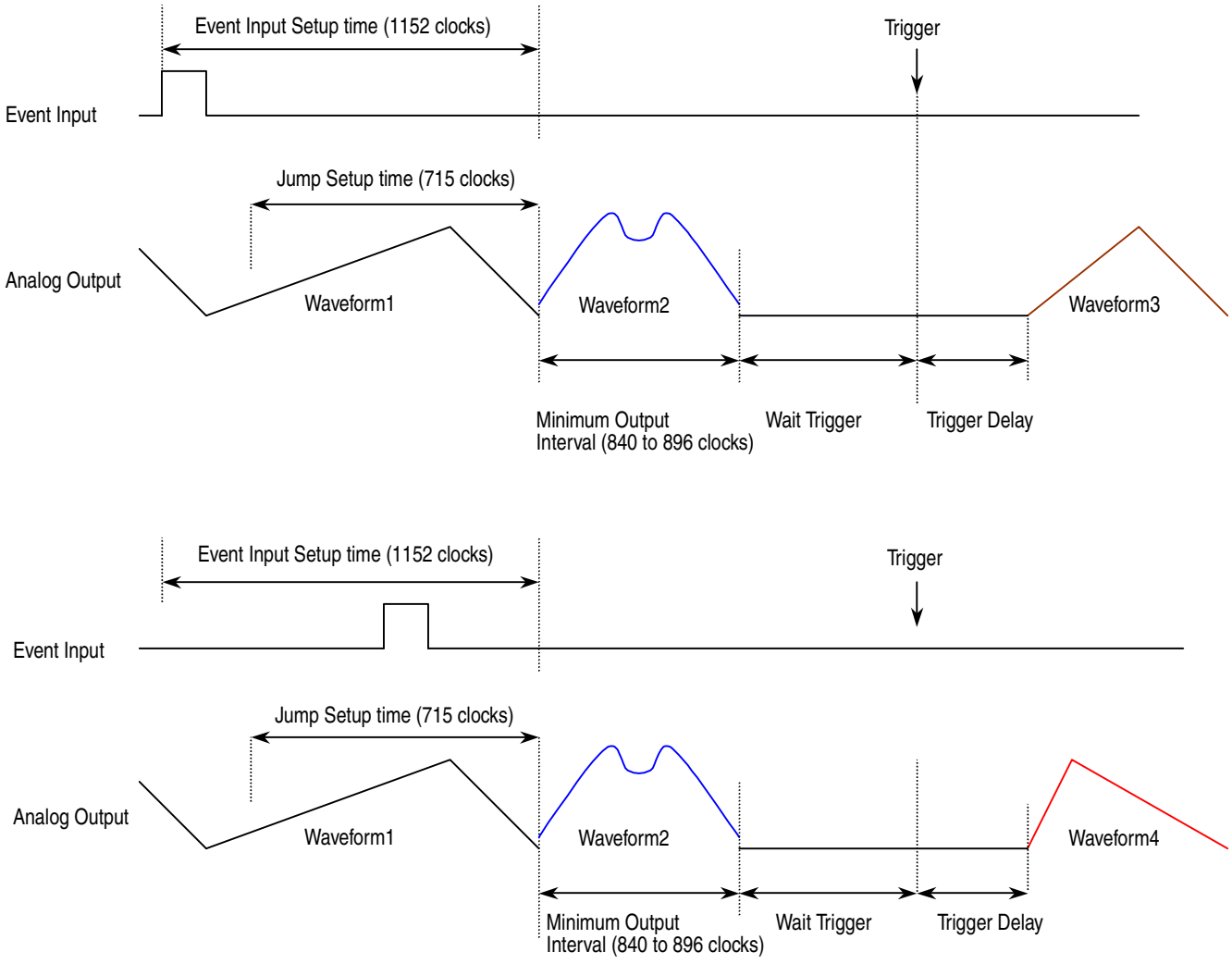


Figure A-4: Sequence 2

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3. Sequence 3

Line No.	Waveform Name	Wait for Trigger	Jump to
n:	Waveform1	Off	m (Waveform3)
n+1:	Waveform2	On	m+1 (Waveform4)
m:	Waveform3	Off	--
m+1:	Waveform4	Off	--

3-1.

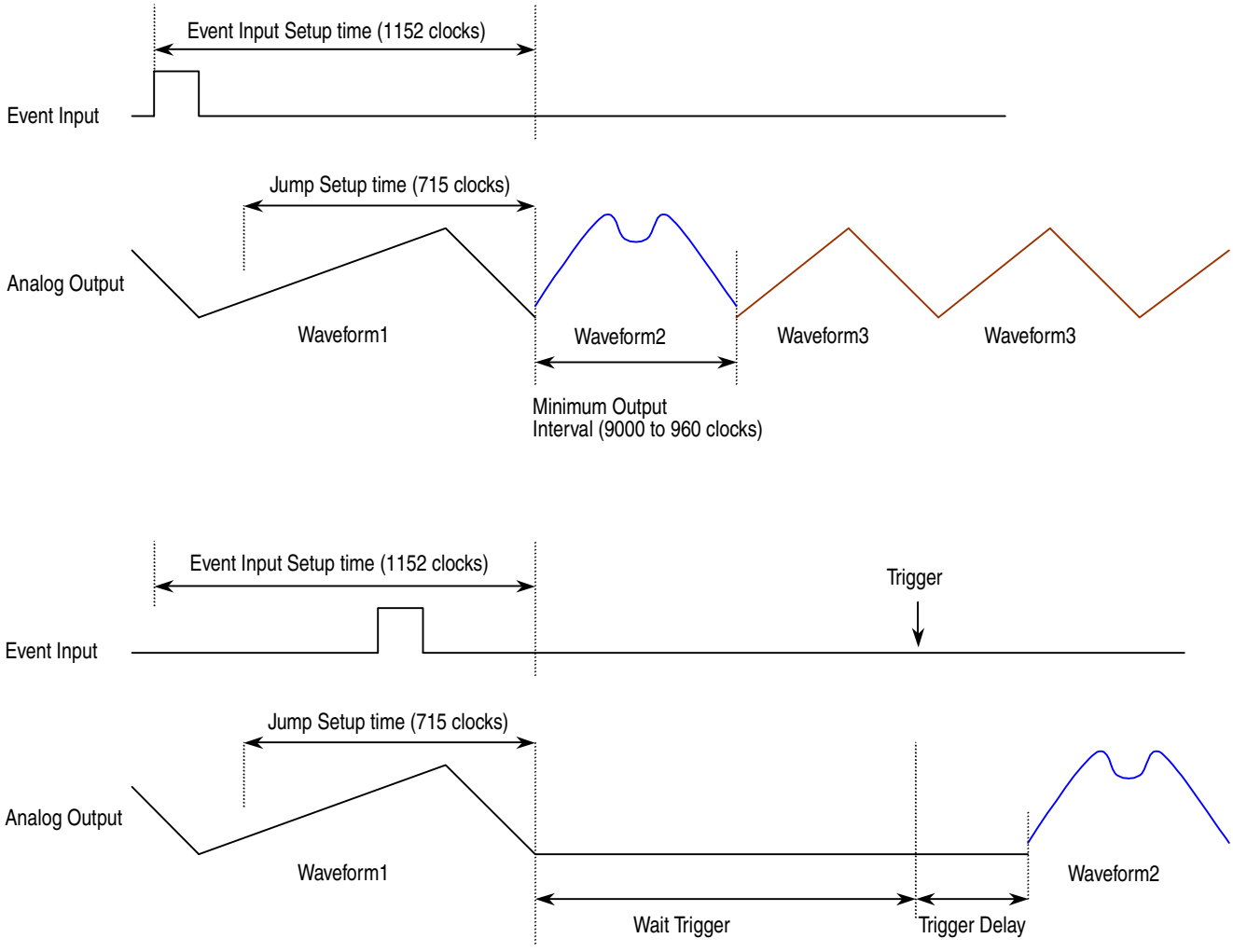


Figure A-5: Sequence 3

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4. Sequence 4

Line No.	Waveform Name	Wait for Trigger	Jump to
n:	Waveform1	Off	m (Waveform3)
n+1:	Waveform2	On	m+1 (Waveform4)
m:	Waveform3	On	--
m+1:	Waveform4	On	--

4-1.

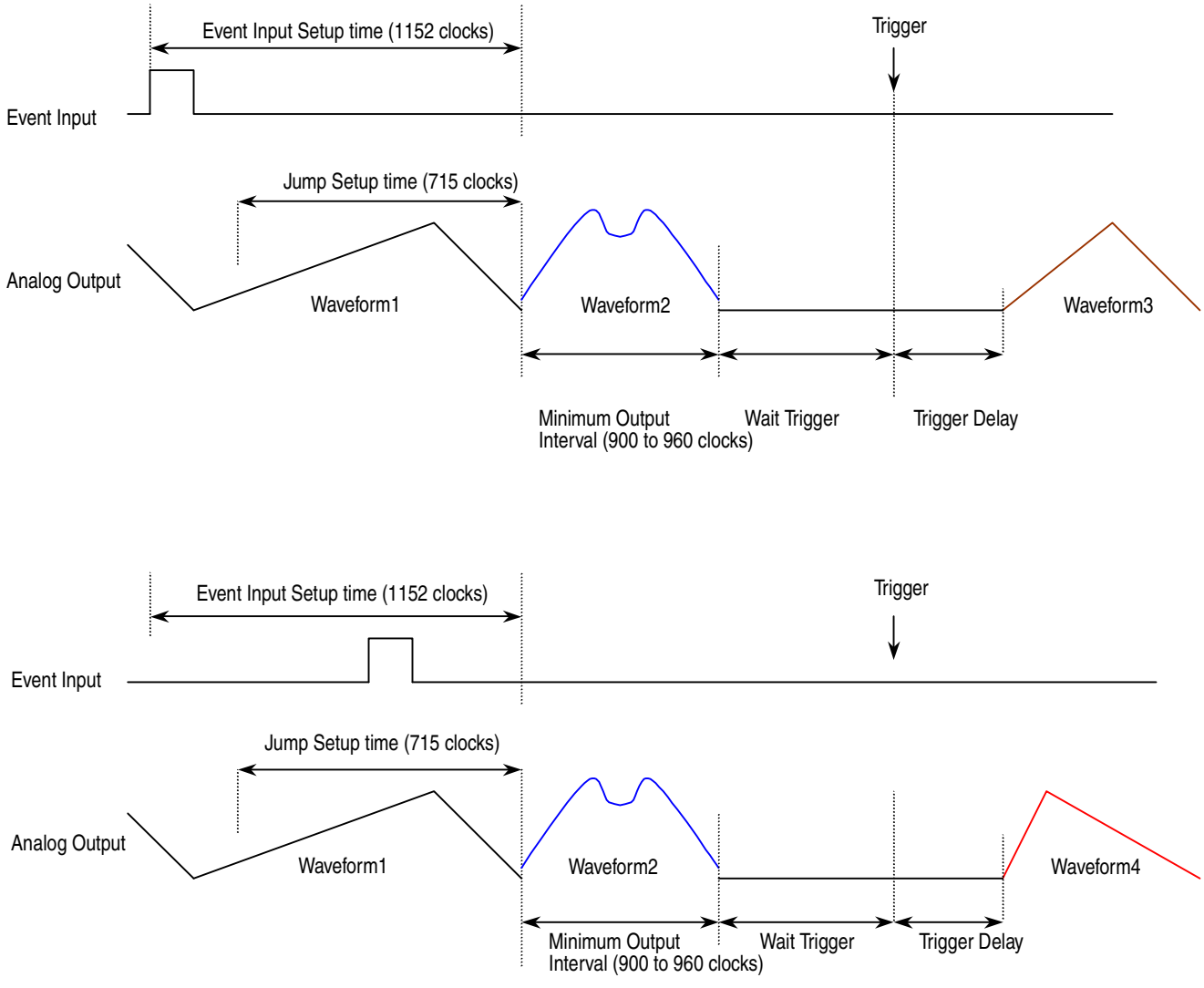


Figure A-6: 3-1. Sequence 4

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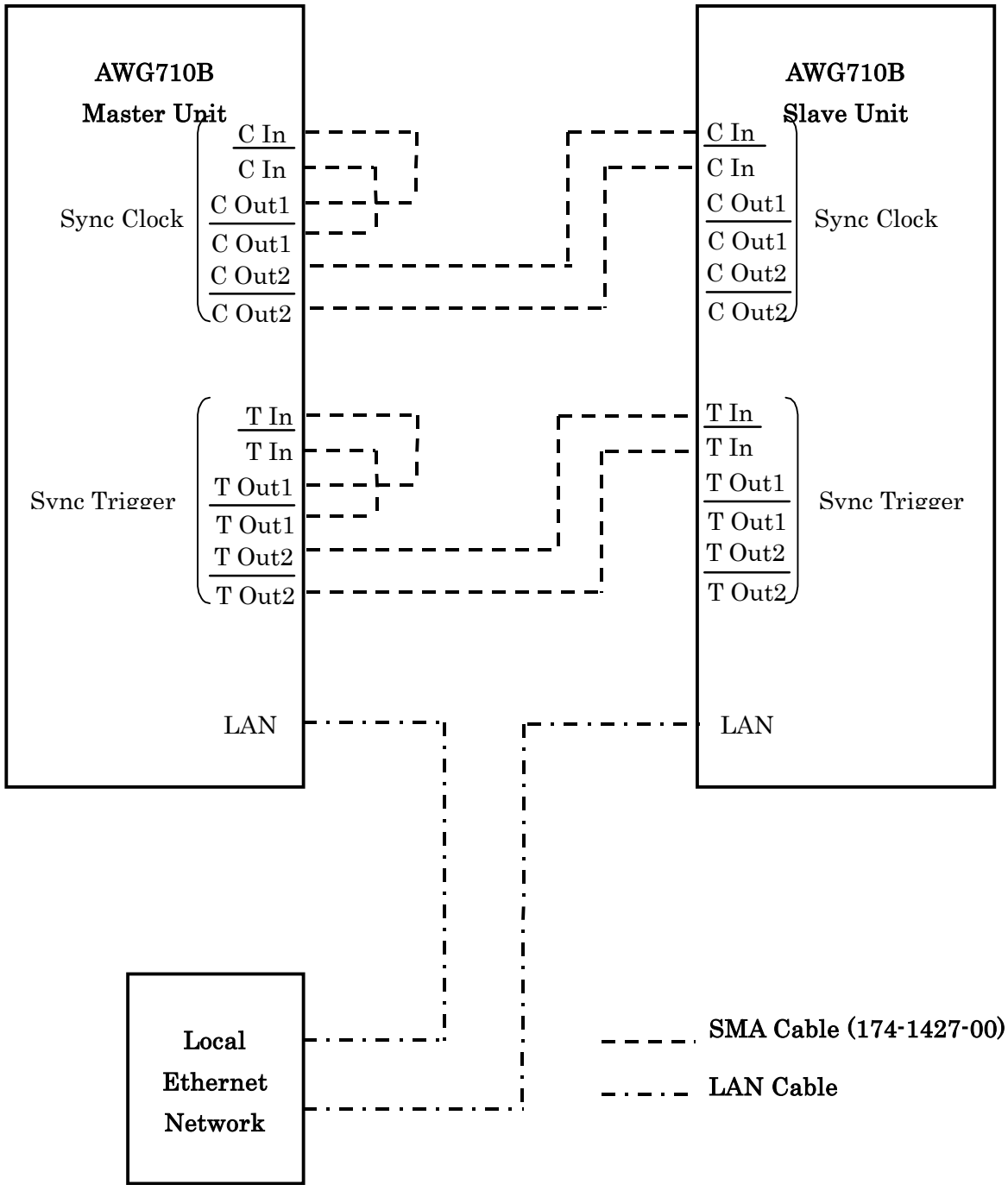


Figure A-7: The cable connection between units in Synchronous operation

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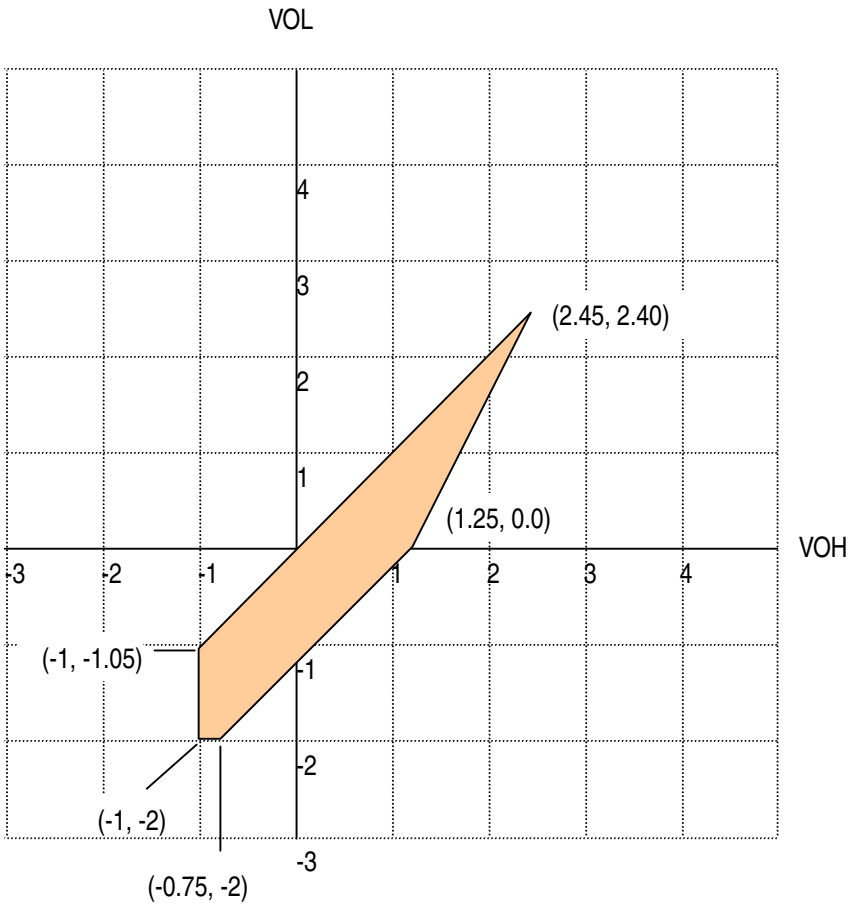


Figure A-8: Output Voltage Window (into 50Ω to GND) of MARKER

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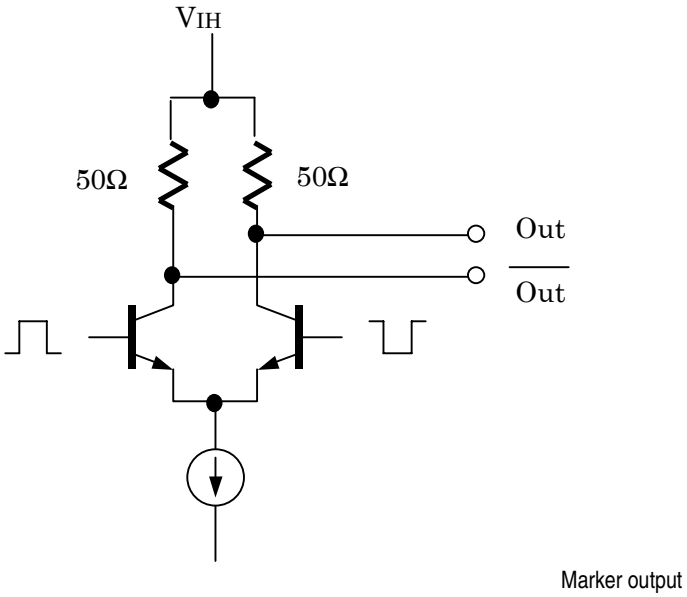


Figure A-9: Output part equivalent circuit of MARKE

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Table A-14: Event Input

Characteristics	Description
Connector	9–pin, D type on the rear panel
Number of events	7 bits
Input signal	7 event bits and Strobe
Threshold	TTL level
Maximum input	0 V to + 5 V (DC + peak AC)
Impedance	1 kΩ, pull–up to +3.3 V
Enhanced mode	
Minimum pulse width	320 clocks + 10 ns
Event hold off time	(The time interval between the last event input point and the next acceptable event input point) ≤ 896 clocks + 20 ns
Delay to analog out, Typical (Jump timing: ASYNC)	(Output: Norm, Filter: Through)
Strobe: On	1691.5 clocks + 10 ns
Strobe: Off	1947.5 clocks + 6 ns
Event input to strobe input	
Setup time	192 clocks + 10 ns
Hold time	192 clocks + 10 ns

Table A-15: 10 MHz reference clock input

Characteristics	Description
Input voltage range	0.2 $V_{p–p}$ to 3.0 $V_{p–p}$ (into a 50 Ω load, AC coupling) Maximum ± 10 V
Impedance	50 Ω, AC coupling
Frequency range	10 MHz ± 0.1 MHz
Connector	Rear panel BNC connector

Table A-16: External clock input

Characteristics	Description
Connector	Rear panel SMA connector
Impedance	50 Ω, AC coupling
Required input voltage range swing	0.4 $V_{p–p}$ to 2 V_{p-p} into a 50 Ω load
Required duty cycle	50 ± 5 %

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Table A-16: External clock input

Characteristics	Description
Frequency range	125 MHz to 4.2 GHz Note: Slew rate should be more than 10 mV/ns.

Table A-17: C input

Characteristics	Description
Connector	This signal is used for only Synchronous operation between Master and Slave unit. Rear panel SMA connector
Input signal type	Complementary

Table A-18: T input

Characteristics	Description
Connector	This signal is used for only Synchronous operation between Master and Slave unit. Rear panel SMA connect
Input signal type	Complementary

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Table A-19: Function Generator (FG)

Characteristics	Description
Operation Mode	Continuous mode only
Waveform Shape	Sine, Triangle, Square, Ramp, Pulse, DC
Frequency	1.000 Hz to 400.0 MHz
Amplitude	
Range	0.020 V_{p-p} to 2.000 V_{p-p}, into a 50 Ω load (OPTION02 : 0.5 V_{p-p} to 1.0 V_{p-p}, into a 50 Ω load)
Resolution	1 mV
Offset (except option 02)	
Range	-0.500 V to +0.500 V, into a 50 Ω load
Resolution	1 mV
DC Level (except option 02)	DC waveform only
Range	-0.500 V to +0.500 V, into a 50 Ω load
Resolution	1 mV
Polarity	Normal, Inverted
Duty	
Range	0.1 % to 99.9 %
Resolution	Frequency — Resolution 1.000 Hz to 4.000 MHz — 0.1 % 4.001 MHz to 20.00 MHz — 0.5 % 20.01 MHz to 40.00 MHz — 1.0 % 40.01 MHz to 80.00 MHz — 2.0 % 80.01 MHz to 100.0 MHz — 2.5 % 100.1 MHz to 160.0 MHz — 4.0 % 160.1 MHz to 200.0 MHz — 5.0 % 200.1 MHz to 400.0 MHz — 10.0 %
Marker Out	
Pulse Width	
Mrker1	Hi : 0 % to 20 % of 1 waveform period Lo : 20% to 100 % of 1 waveform period
Marker2	Hi : 0 % to 50 % of 1 waveform period Lo : 50 % to 100 % of 1 waveform period Hi : 0 % to 52 % of 1 waveform period Lo : 52 % to 100 % of 1 waveform period at frequency range is 100.1MHz to 160.0MHz
Level	
Hi	1.0 V min into a 50 Ω load
Lo	0 V max into a 50 Ω load

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Table A-20: Display

Characteristics	Description
Display	
Size	16 cm (6.4 in.) diag. LCD
Display area	Horizontal: 130.6 mm (5.14 in)
	Vertical: 97.0 mm (3.81 in)
Resolution	640 (H) × 480 (V) pixels

Table A-21: AC line power

Characteristics	Description
Rating voltage	100 VAC to 240 VAC, CAT II
Voltage range	90 VAC to 250 VAC
Frequency range	48 Hz to 63 Hz
Maximum consumption	240 VA
Maximum current	5 A
Fuse rating	10 A fast, 250 V, UL 198G (3 AG) 5 A (T), 250 V, IEC 127

Table A-22: Timer

Characteristics	Description
Timer	
Operation time	6 years
Type	Li 3 V, 190 mAh

Table A-23: Interface connectors

Characteristics	Description
GPIB	24–pin, IEEE 488.1 connector on the rear panel
Ethernet	100/10 BASE–T, RJ–45 connector on the rear panel
Keyboard connector	6–pin, mini–DIN connector on the rear panel

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Table A-24: Installation requirement

Characteristics	Description	
Heat dissipation		
Maximum power	220 W max. (maximum line current: 3 A_{rms}, at 50 Hz)	
Surge current	30 A (25 °C) peak for equal to or less than 5 line cycles, after the instrument has been turned off for at least 30s	
Cooling clearance	Top, Bottom	2 cm (0.8 in) 2 cm (0.8 in) ***NOTE:*** *The feet on the bottom provide the required clearance when set on a flat surface.*
	Sides	15 cm (6 in)
	Rear	7.5 cm (3 in)

Table A-25: Maintenance requirement

Characteristics	Description
Calibration	The instrument should be fully calibrated at least every 12 months.

Table A-26: Environmental

Characteristics		Description
Atmospherics		
Temperature		
	Operating	+10 °C to +40 °C
	Non-operating	-20 °C to +60 °C
Relative humidity		
	Operating	20 % to 80 % (no condensation) Maximum wet–bulb temperature 29.4 °C
	Non-operating	5 % to 90 % (no condensation) Maximum wet–bulb temperature 40.0 °C
Altitude		(Hard disk drive restriction)
	Operating	Up to 3 km (10 000 ft) Maximum operating temperature decreases 1 °C each 300 m (1 000 ft) above 1.5 km (5 000 ft)
	Non-operating	Up to 12 km (40 000 ft)

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Table A-26: Environmental

Dynamics	
Random vibration	
Operating	2.646 m/s^2 rms (0.27Grms), from 5 Hz to 500 Hz, 10 minutes
Non-operating	22.344 m/s^2 rms (2.28Grms), from 5 Hz to 500 Hz, 10 minutes
Shock	
Non-operating	294 m/s^2 (30 G), half–sine, 11 ms duration

Table A-27: Mechanical

Characteristics	Description	
Net weight (without package)	14.1 kg (31.1 lb) Opt. 11:16.1 kg (35.5 lb)	
Dimensions (without package)	Height	177 mm (6.97 in) 193 mm (7.60 in) with Feet Opt.11: 216 mm (8.50 in) 232 mm (9.13 in) with Feet
	Width	424 mm (16.69 in) 433 mm (17.05 in) with Handle
	Length	470 mm (18.50 in) 508 mm (20.00 in) with Rear Feet
Net weight (with package)	24.5 kg (54.0 lb)	
Dimensions (with package)	Height	400 mm (15.75 in)
	Width	550 mm (21.65 in)
	Length	700 mm (27.56 in)

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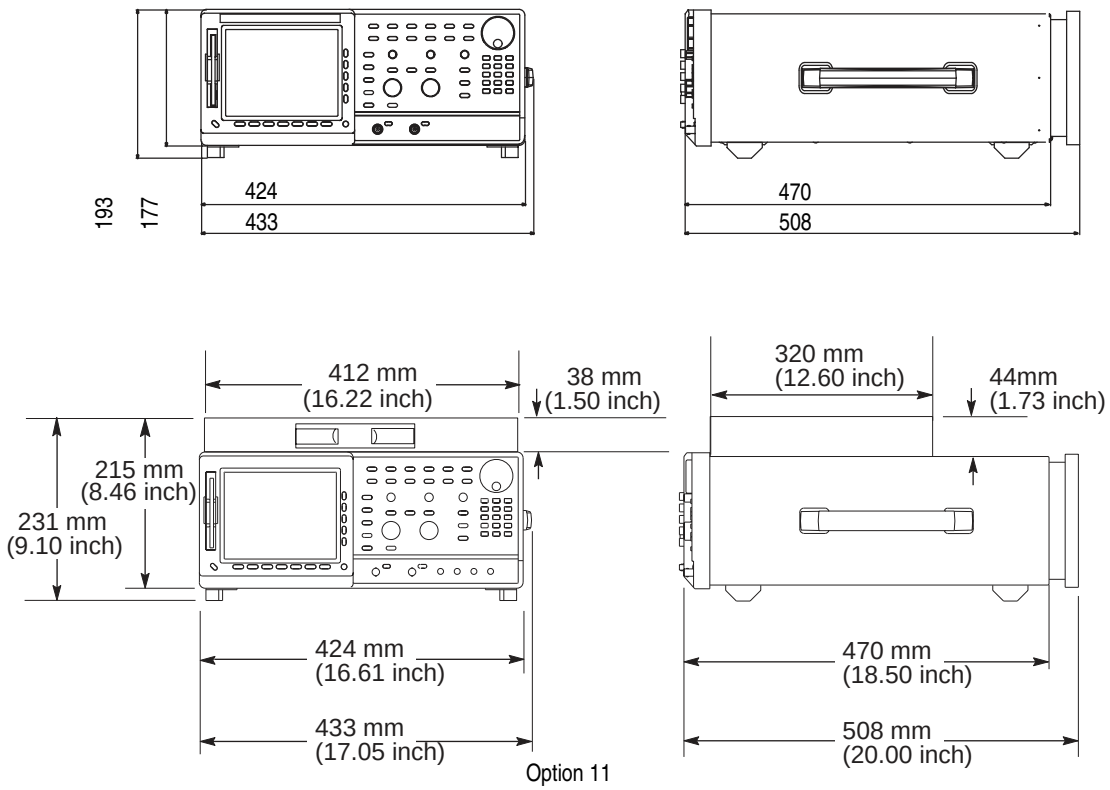


Figure A-10: Dimensions

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Certification and Compliances

The certification and compliances for the AWG710B Arbitrary Waveform Generator are listed in Table A-28.

Table A-28: Certifications and compliances

Characteristics	Description
EC declaration of conformity	EC council EMC Directive 89/336/EEC, amended by 89/336/EEC; EN61326-1: 1997 Product Family Standard for Electrical Equipment for Measurement, Control, and Laboratory Use-EMC Requirements. Emissions: EN 55011 Class A — Radiated and Conducted emissions EN 61000–3–2 — Power Line Harmonic EN 61000–3–3 — Line voltage alteration and flicker Immunity: EN50082–1 EN 61000–4–2 — Electrostatic Discharge Immunity EN 61000–4–3 — Radiated RF Electromagnetic Field Immunity EN 61000–4–5 — Surge Immunity EN 61000–4–6 — Conducted Disturbances Induced by RF Field Immunity EN 61000–4–4[6] — Electrical Fast Transient/Burst Immunity EN 61000–4–8 — Power Frequency Electromagnetic EN 61000–4–11 — Power Line Interruption Immunity Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive 73/23/EEC, amended by 93/68/EEC EN 61010–1/A2:1995 — Safety requirements for electrical equipment for measurement, control, and laboratory use
Australia/New Zealand declaration of conformity - EMC	Conforms with the following standards in accordance with the Electromagnetic Compatibility Framework: AS/NZS 2064.1/2 Class A radiated and Conducted Emissions
Safety **Third party certification** **Self declaration**	UL3111–1 - Standard for electrical measuring and test equipment CAN/CSA C22.2 No. 1010.1 - Safety requirements for electrical equipment for measurement, control and laboratory use IEC 61010–1/A2:1995 - Safety requirements for electrical equipment for measurement, control, and laboratory use
Installation category	Power input — Installation Category II (as defined in IEC 61010–1, Annex J)

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Table A-28: Certifications and compliances

Characteristics	Description
Pollution degree	Pollution Degree 2 (as defined in IEC 61010–1)

6 Up to 200 mV $_{p–p}$ noise is allowed on the output during this test.

Table A-29: Installation category and Pollution degree Descriptions

Characteristics	Description	
Installation category	Terminals on this product may have different installation category designations. The installation categories are:	
	Category	*Descriptions*
	CAT IIIe	Distribution–level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location
	CAT II	Local–level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord–connected
	CAT I	Secondary (signal level) or battery operated circuits of electronic equipment
Pollution degree	A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.	
	Category	*Descriptions*
	Pollution Degree 1	No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
	Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
	Pollution Degree 3	Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

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Appendix A: Specifications (AWG710)

This section contains theAWG710 Arbitrary Waveform Generator specifications. All specifications are guaranteed unless labeled “typical”. Typical specifications are provided for your convenience but are not guaranteed.

Specifications that are marked with the ✓ symbol in the column Characteristics are checked in *Appendix B: Performance Verification* and the page number referenced to the corresponding performance verification procedures can be found in the column PV reference page.

The characteristics in the specifications are listed in tables that are divided into categories. In these tables, the subcategories may also appear in boldface under the column Characteristics.

Performance Conditions

The performance limits in this specification are valid with these conditions:

- The AWG710 Arbitrary Waveform Generator must have been calibrated/adjusted at an ambient temperature between +20° C and +30° C.
- The AWG710 Arbitrary Waveform Generator must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.
- The AWG710 Arbitrary Waveform Generator must have had a warm–up period of at least 20 minutes.
- The AWG710 Arbitrary Waveform Generator must be operating at an ambient temperature between +10° C and +40° C.

Warranted characteristics are described in terms of quantifiable performance limits which are warranted.

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Electrical Specification

Table A-30: Operation modes

Characteristics	Description
Continuous	Waveform is continuously output in this mode. When a sequence is defined, waveforms are sequentially or repeatedly output in the order defined by the sequence. The extended sequence functions such as trigger input, event jump, and so on are neglected in this mode.
Triggered	Waveform is output only once when a trigger event is created. A trigger signal is created by the external trigger input signal, GPIB trigger command, and/or pressing the front–panel FORCE TRIGGER button. The extended sequence functions such as trigger input, event jump, and so on are neglected in this mode.
Gated	The waveform is output in the same way as in the continuous mode only when the gate is opened. The gate is opened by the gated signal. Note that the output is made from the top of the first waveform for every gate period. The clock signal continuously outputs from the connector outside the gate period.
Enhanced	The waveforms are sequentially or repeatedly output according to the procedures defined in the sequence. All extended functions such as trigger input, event jump, and so on are effective and waveforms are controlled for output by this functions in this mode.

Table A-31: Arbitrary waveforms

Characteristics	Description
Waveform memory	Memory length: 16 200 000 words (8 bits/1 word)
Op.01	Memory length: 32 400 000 words (8 bits/1 word)
Marker memory	Memory length: 16 200 000 words (2 markers × 1 bit / 1 word)
Op.01	Memory length: 32 400 000 words (2 markers × 1 bit / 1 word)
Sequence memory	Maximum 8000 steps
Sequence counter	1 to 65 536 and Infinite
Waveform data points	Multiple of 4 in the range from 960 to 16 200 000 points
Op.01	Multiple of 4 in the range from 960 to 32 400 000 points
Data storage	
Hard disk	10 G bytes
Floppy disk	1.44 M bytes

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Table A-32: Clock generator

Characteristics	Description	PV reference page
Sampling frequency	50.000 000 kHz to 4.000 000 0 GHz	
Resolution	8 digits	
Internal clock [1]		
✓ Frequency accuracy	± 1 ppm (10 °C to 40 °C), during 1 year after calibration	Page B-98
Phase noise at 1/4 clock output, Typical	(Data Clock is 1/4th of the output sample rate) -80 dBc / Hz (1 GHz with 10 kHz offset) -100 dBc/Hz (1 GHz with 100 kHz offset)	

[1] **The internal reference oscillator is used.**

Table A-33: Internal trigger generator

Characteristics	Description	PV reference page
Internal trigger rate [2]		
Accuracy	± 0.1 %	
Range	1.0 µs to 10.0 s	
Resolution	3 digits, minimum 0.1 µs	

[2] **The internal reference oscillator is used.**

Table A-34: Main output

Characteristics [3]	Description	PV reference page
Output connector	front–panel SMA connectors	
Output signal	Complemental; CH1 and $\overline{\text{CH1}}$	
DA converter		
Resolution	8 bits	
Differential nonlinearity	Within ± 1/2 LSB	
Integral nonlinearity	Within ± 1 LSB	
Output impedance	50 Ω	
Normal out (except option 02)		
Output voltage	-1.5 V to +1.5 V, into a 50 Ω load	
Amplitude		
Range	20 mV_{p-p} to 2 V_{p-p}, into a 50 Ω load	
Resolution	1 mV	
✓ DC accuracy	± (2.0 % of amplitude + 2 mV), offset: 0 V	Page B-72

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Table A-34: Main output

Characteristics [3]	Description	PV reference page
Offset		
Range	-0.5 V to 0.5 V, into a 50 Ω load	
Resolution	1 mV	
✓Accuracy	± 1.5 % of offset ± 10 mV, (20 mV amplitude, waveform data: 0)	Page B-72
Pulse response	(Waveform data: -1 and 1, offset: 0 V, and filter: through)	
✓Rise time (10 % to 90 %)	≤ 480 ps (amplitude = 1.0 V_{p-p}, calculated value ≥ 729 MHz)	Page B-85
✓Fall time (10 % to 90 %)	≤ 480 ps (amplitude = 1.0 V_{p-p}, calculated value ≥ 729 MHz)	
Aberration, Typical	± 6 % (amplitude + 1.0 V_{p-p}, using 6 GHz bandwidth oscilloscope)	
Flatness, Typical	± 3 % (after 20 ns from rise and fall edges)	
Sinewave characteristics	(Clock: 4.0 GS/s, waveform points: 32, Signal frequency: 125 MHz, amplitude: 1.0 V, offset: 0 V, filter: through)	
Harmonics	≤ -40 dBc (DC to 1000 MHz)	
Noise	≤ -50 dBc (DC to 1000 MHz)	
Phase Noise, Typical	≤ -85 dBc / Hz (at 10 kHz offset)	
Direct DA out (except option 02)		
Amplitude		
Range	20 mV_{p-p} to 1 V_{p-p}, into a 50 Ω load	
✓DC Accuracy	± (2 % of Amplitude + 2 mV)	Page B-77
Resolution	1 mV	
✓ DC offset accuracy	0 V ± 10 mV, (20 mV amplitude, waveform data: 0)	Page B-77
✓ Pulse response	(Waveform data: -1 and 1, at 0.5 V_{p-p})	Page B-79
Rise time (10 % to 90 %)	≤ 280 ps (calculated value ≥ 1.25 GHz)	
Fall time (10 % to 90 %)	≤ 280 ps (calculated value ≥ 1.25 GHz)	
Extended Bandwidth output (option 02)		
Amplitude		
Range	500 mV_{p-p} to 1 V_{p-p}, into a 50 Ω load	
✓DC Accuracy	± (2 % of Amplitude + 2 mV)	Page B-81
Resolution	1 mV	
✓ DC offset accuracy	0 V ± 10 mV, (500 mV amplitude, waveform data: 0)	Page B-81
✓ Pulse response	(Waveform data: -1 and 1, at 1 V_{p-p})	Page B-83
Rise time (10 % to 90 %)	≤ 175 ps (calculated value ≥ 2 GHz)	
Fall time (10 % to 90 %)	≤ 175 ps (calculated value ≥ 2 GHz)	

[3] **The characteristics are specified at the end of the SMA cable (012–1565–00) except for DC accuracy.**

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Table A-35: Filter (except option 02)

Characteristics	Description	
Type	Bessel low pass filter, 200 MHz,100 MHz, 50 MHz, and 20 MHz	
Rise time (10 % to 90 %), Typical	20 MHz 50 MHz 100 MHz 200 MHz	17 ns 7 ns 3.7 ns 2 ns
Group delay, Typical	20 MHz 50 MHz 100 MHz 200 MHz	18 ns 8 ns 4.7 ns 3 ns

Table A-36: Auxiliary outputs

Characteristics	Description	PV reference page
Marker [4]		
Number of markers	2 (Complementary). Marker1, $\overline{\text{Marker1}}$, Marker2, and $\overline{\text{Marker2}}$	
Level (Hi/Lo)	-1.10 V to +3.00 V, into a 50 Ω load -2.20 V to +6.00 V, into a 1 MΩ load	
Maximum Output	2.5 V_{p-p}, into a 50 Ω load	
Resolution	0.05 V	
✓ Accuracy	± 0.1 V ± 5 % of setting, into a 50 Ω load	Page B-100
Rise and fall times (20 % to 80 %), Typical	150 ps (2 V_{p-p}, Hi: +1 V, Lo: -1 V, into a 50 Ω load)	
Skew, Typical	70 ps	
Period jitter, Typical	Measured by TDS694C with options 1M and HD and TDSJIT1. Refer to Table A-37.	
Cycle to cycle jitter, Typical	Measured by TDS694C with options 1M and HD and TDSJIT1. Refer to Table A-38.	
Connector	Front panel SMA connectors	
1/4 Clock output		
Level	ECL 100 K compatible (internally loaded in 50 Ω to -2 V and 47 Ω series terminated)	
Period jitter, Typical	Measured by TDS694C with options 1M and HD and TDSJIT1. Refer to Table A-37.	
Cycle to cycle jitter, Typical	Measured by TDS694C with options 1M and HD and TDSJIT1. Refer to Table A-38.	
Connector	Rear panel SMA connector	

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Table A-36: Auxiliary outputs

Characteristics	Description	PV reference page
10 MHz Reference clock out		
Amplitude, Typical	≥ 1.2 V_{p-p}, into a 50 Ω load, Max 2.5 V_{p-p}, open circuit	
Impedance	50 Ω, AC coupling	
Connector	Rear panel BNC connector	

[4] **The characteristics are specified at the end of the SMA cable (012–1565–00).**

Table A-37: Period Jitter

Clock frequency	4 GS/s		2 GS/s		1 GS/s	
Measurement	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
Marker output	1.6 ps	11.6 ps	1.9 ps	13.4 ps	2.5 ps	15.1 ps
1/4 Clock output	2.6 ps	20.2 ps	2.4 ps	27.5 ps	1.9 ps	14.0 ps

Table A-38: Cycle to Cycle Jitter

Clock frequency	4 GS/s		2 GS/s		1 GS/s	
Measurement	StdDev	Pk-Pk	StdDev	Pk-Pk	StdDev	Pk-Pk
Marker output	3.1 ps	21.4 ps	3.2 ps	26.1 ps	3.1 ps	21.9 ps
1/4 Clock output	4.8 ps	44.5 ps	3.7 ps	33.3 ps	3.1 ps	28.7 ps

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Table A-39: Auxiliary inputs

Characteristics	Description	PV reference page
Trigger input [5]		
Connector	Rear panel BNC connector	
Impedance	1 kΩ or 50 Ω	
Polarity (Trigger mode)/Slope (Gated mode)	POS (positive) or NEG (negative)	
Input voltage range	± 10 V, into a 1 kΩ load ± 5 V, into a 50 Ω load	
Threshold		
Level	-5.0 V to 5.0 V	
✓ Accuracy	± 5 % of level ± 0.1 V	Page B-87
Resolution	0.1 V	
Triggered mode	See Figure A-11	
Minimum pulse width	10 ns, 0.2 V amplitude	
Trigger hold off time	≤ 109.5 clocks + 500 ns	
Delay to analog out, Typical	211.5 clocks + 17 ns (Output: Norm, Filter: Through)	
Gated mode		
Minimum pulse width	1152 clocks + 10 ns, 0.2 V amplitude	
Gate hold off time	≤ 1920 clock + 20 ns	
Delay to analog out, Typical	(1335 to 1499.5) clocks + 9 ns (Output: Norm, Filter: Through)	

[5] **The characteristics are specified at the end of the BNC cable (012–0482–00).**

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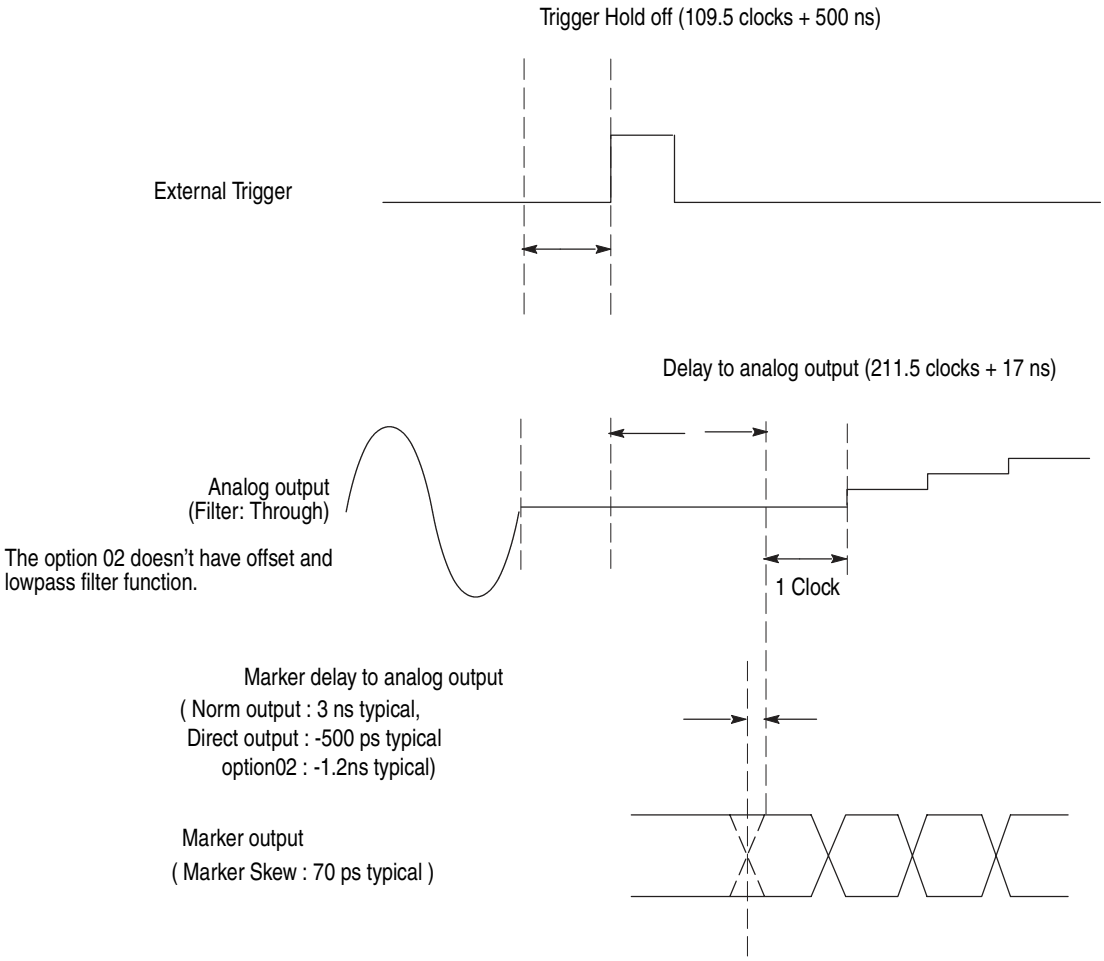


Figure A-11: Signal Timing

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Table A-40: Event Input

Characteristics	Description
Connector	9–pin, D type on the rear panel
Number of events	4 bits
Input signal	4 event bits and Strobe
Threshold	TTL level
Maximum input	0 V to + 5 V (DC + peak AC)
Impedance	1 kΩ, pull–up to +3.3 V
Enhanced mode	
Minimum pulse width	320 clocks + 10 ns
Event hold off time	≤ 896 clocks + 20 ns
Delay to analog out, Typical (Jump timing: ASYNC)	(Output: Norm, Filter: Through)
Strobe: On	1627.5 clocks + 7 ns
Strobe: Off	1883.5 clocks + 5 ns
Event input to strobe input	
Setup time	192 clocks + 10 ns
Hold time	192 clocks + 10 ns

Table A-41: 10 MHz reference clock input

Characteristics	Description
Input voltage range	0.2 V to 3.0 V_{p-p} (into a 50 Ω load, AC coupling) Maximum ± 10 V
Impedance	50 Ω, AC coupling
Reference frequency	10 MHz ± 0.1 MHz
Connector	Rear panel BNC connector

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Table A-42: Function Generator (FG)

Characteristics	Description
Operation Mode	Continuous mode only
Waveform Shape	Sine, Triangle, Square, Ramp, Pulse, DC
Frequency	1.000 Hz to 400.0 MHz
Amplitude	
Range	0.020 V_{p-p} to 2.000 V_{p-p}, into a 50 Ω load (OPTION02 : 0.5 V_{p-p} to 1.0 V_{p-p}, into a 50 Ω load)
Resolution	1 mV
Offset (except option 02)	
Range	-0.500 V to +0.500 V, into a 50 Ω load
Resolution	1 mV
DC Level (except option 02)	DC waveform only
Range	-0.500 V to +0.500 V, into a 50 Ω load
Resolution	1 mV
Polarity	Normal, Inverted
Duty	
Range	0.1 % to 99.9 %
Resolution	Frequency — Resolution 1.000 Hz to 4.000 MHz — 0.1 % 4.001 MHz to 20.00 MHz — 0.5 % 20.01 MHz to 40.00 MHz — 1.0 % 40.01 MHz to 80.00 MHz — 2.0 % 80.01 MHz to 100.0 MHz — 2.5 % 100.1 MHz to 160.0 MHz — 4.0 % 160.1 MHz to 200.0 MHz — 5.0 % 200.1 MHz to 400.0 MHz — 10.0 %
Marker Out	
Pulse Width	
Mrker1	Hi : 0 % to 20 % of 1 waveform period Lo : 20% to 100 % of 1 waveform period
Marker2	Hi : 0 % to 50 % of 1 waveform period Lo : 50 % to 100 % of 1 waveform period Hi : 0 % to 52 % of 1 waveform period Lo : 52 % to 100 % of 1 waveform period at frequency range is 100.1MHz to 160.0MHz
Level	
Hi	2.0 V min into a 50 Ω load
Lo	0 V max into a 50 Ω load

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Table A-43: Display

Characteristics	Description
Display	
Display area	Horizontal: 130.6 mm (5.14 in)
	Vertical: 97.0 mm (3.81 in)
Resolution	640 (H) × 480 (V) pixels
Size	16 cm (6.4 in.) diag. LCD

Table A-44: AC line power

Characteristics	Description
Rating voltage	100 VAC to 240 VAC, CAT II
Voltage range	90 VAC to 250 VAC
Frequency range	48 Hz to 63 Hz
Maximum consumption	220 VA
Maximum current	5 A
Fuse rating	10 A fast, 250 V, UL 198G (3 AG) 5 A (T), 250 V, IEC 127

Table A-45: Timer

Characteristics	Description
Timer	
Operation time	6 years
Type	Li 3 V, 190 mAh

Table A-46: Interface connectors

Characteristics	Description
GPIB	24–pin, IEEE 488.1 connector on the rear panel
Ethernet	100/10 BASE–T, RJ–45 connector on the rear panel
Keyboard connector	6–pin, mini–DIN connector on the rear panel

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Table A-47: Installation requirement

Characteristics	Description	
Heat dissipation		
Maximum power	220 VA (maximum line current: 3 A_{rms}, at 50 Hz)	
Surge current	30 A (25 °C) peak for equal to or less than 5 line cycles, after the instrument has been turned off for at least 30s	
Cooling clearance	Top,	2 cm (0.8 in)
	Bottom	2 cm (0.8 in) ***NOTE:*** *The feet on the bottom provide the required clearance when set on a flat surface.*
	Sides	15 cm (6 in)
	Rear	7.5 cm (3 in)

Table A-48: Environmental

Characteristics	Description
Atmospherics	
Temperature	
Operating	+10 °C to +40 °C
Non-operating	-20 °C to +60 °C
Relative humidity	
Operating	20 % to 80 % (no condensation) Maximum wet–bulb temperature 29.4 °C
Non-operating	5 % to 90 % (no condensation) Maximum wet–bulb temperature 40.0 °C
Altitude	(Hard disk drive restriction)
Operating	Up to 3 km (10 000 ft) Maximum operating temperature decreases 1 °C each 300 m (1 000 ft) above 1.5 km (5 000 ft)
Non-operating	Up to 12 km (40 000 ft)
Dynamics	
Random vibration	
Operating	2.65 m/s^2 rms (0.27Grms), from 5 Hz to 500 Hz, 10 minutes
Non-operating	22.36 m/s^2 rms (2.28Grms), from 5 Hz to 500 Hz, 10 minutes
Shock	
Non-operating	294 m/s^2 (30 G), half–sine, 11 ms duration

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Table A-49: Mechanical

Characteristics	Description	
Net weight (without package)	14.1 kg (31.1 lb)	
Dimensions (without package)	Height	177 mm (6.97 in) 193 mm (7.60 in) with Feet
	Width	424 mm (16.69 in) 433 mm (17.05 in) with Handle
	Length	470 mm (18.50 in) 508 mm (20.00 in) with Rear Feet
Net weight (with package)	24.5 kg (54.0 lb)	
Dimensions (with package)	Height	400 mm (15.75 in)
	Width	550 mm (21.65 in)
	Length	700 mm (27.56 in)

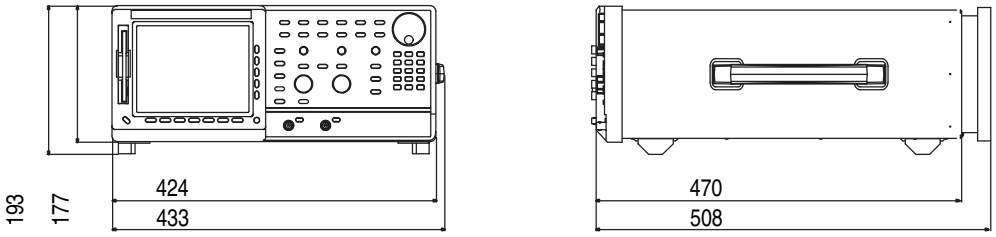


Figure A-12: Dimensions

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Certification and Compliances

The certification and compliances for the AWG710 Arbitrary Waveform Generator are listed in Table A-50.

Table A-50: Certifications and compliances

Characteristics	Description
EC declaration of conformity	EC council EMC Directive 89/336/EEC, amended by 89/336/EEC; EN61326-1: 1997 Product Family Standard for Electrical Equipment for Measurement, Control, and Laboratory Use-EMC Requirements. Emissions: EN 55011 Class A — Radiated and Conducted emissions EN 61000–3–2 — Power Line Harmonic Immunity: EN 61000–4–2 — Electrostatic Discharge Immunity EN 61000–4–3 — Radiated RF Electromagnetic Field Immunity EN 61000–4–4[6] — Electrical Fast Transient/Burst Immunity EN 61000–4–5 — Surge Immunity EN 61000–4–6 — Conducted Disturbances Induced by RF Field Immunity EN 61000–4–11 — Power Line Interruption Immunity Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive 73/23/EEC, amended by 93/68/EEC EN 61010–1/A2:1995 — Safety requirements for electrical equipment for measurement, control, and laboratory use
Australia/New Zealand declaration of conformity - EMC	Conforms with the following standards in accordance with the Electromagnetic Compatibility Framework: AS/NZS 2064.1/2 Class A radiated and Conducted Emissions
Safety	UL3111–1 - Standard for electrical measuring and test equipment
Third party certification	CAN/CSA C22.2 No. 1010.1 - Safety requirements for electrical equipment for measurement, control and laboratory use
Self declaration	IEC 61010–1/A2:1995 - Safety requirements for electrical equipment for measurement, control, and laboratory use
Installation category	Power input — Installation Category II (as defined in IEC 61010–1, Annex J)
Pollution degree	Pollution Degree 2 (as defined in IEC 61010–1)

6 Up to 200 mV $_{p-p}$ noise is allowed on the output during this test.

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Table A-51: Installation category and Pollution degree Descriptions

Characteristics	Description	
Installation category	Terminals on this product may have different installation category designations. The installation categories are:	
	Category	*Descriptions*
	CAT IIIe	Distribution–level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location
	CAT II	Local–level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord–connected
	CAT I	Secondary (signal level) or battery operated circuits of electronic equipment
Pollution degree	A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.	
	Category	*Descriptions*
	Pollution Degree 1	No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
	Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
	Pollution Degree 3	Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

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Appendix B: Performance Verification (AWG710B)

Two types of Performance Verification procedures can be performed on this product: *Self Tests* and *Performance Tests*. You may not need to perform all of these procedures, depending on what you want to accomplish.

- Verify that the AWG710B Arbitrary Waveform Generator is operating correctly by running the self tests which begin on page B-2.

  Advantages: These procedures require minimal time to perform, require no additional equipment, and test the internal hardware of the AWG710B Arbitrary Waveform Generator.

- If a more extensive confirmation of performance is desired, complete the self test, and then do the performance test beginning on page B-6.

  Advantages: These procedures add direct checking of warranted specifications. They require more time to perform and suitable test equipment is required. (Refer to *Equipment Required* on page B-7).

Conventions

Throughout these procedures the following conventions apply:

- Each test procedure uses the following general format:

  Title of Test

  Equipment Required

  Prerequisites

  Procedure

- Each procedure consists of as many steps, substeps, and subparts as required to do the test. Steps, substeps, and subparts are sequenced as follows:

  1. First Step

  a. First Substep

  - First Subpart
  - Second Subpart

  b. Second Substep

  2. Second Step

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- Instructions for menu selection use the following format: **front–panel BUTTON→Main Menu Button→Side Menu Button**. For example, Push **UTILITY→System→Reset to Factory→OK**
- The name of the button or knob appears in boldface type:

  Push **EDIT**; then **Drive...**, push **Floppy** side button and use the knob to select SINE.WFM from the file list.

Self Tests

The *Self Tests* use internal routines to confirm basic functionality and proper adjustment. No test equipment is required to do these test procedures.

The self tests include internal diagnostics to verify that the instrument passes the internal circuit tests, and calibration routines to check and adjust the instrument internal calibration constants.

Diagnostics

This procedure uses internal routines to verify that the instrument is operating correctly. No test equipment or hookups are required.

The instrument automatically performs the internal diagnostics when powered on; you can also run the internal diagnostics using the menu selections described in this procedure. The difference between these two methods of initiating the diagnostics is that the menu method does a more detailed memory check than the power–on method.

Equipment required	None
Prerequisites	Power on the instrument and allow a twenty–minute warmup period before doing this procedure.

Confirm that there is no output being performed by verifying that the RUN LED is not on. If the LED is on, push the **RUN** button to turn it off.

Do the following to verify that the instrument passes the internal circuit tests:

Push **UTILITY** (front–panel)→**Diag** (bottom)→**Diagnostic All** (side).

The diagnostic menu is displayed and all tests are selected. Refer to Figure B-1. If All is not displayed, select All using the general purpose knob.

The list on the screen shows the test items and results in the calibration and diagnostics previously made. Select all of the test items shown on the screen or use the general purpose knob to select a single test item that you want to run.

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The result of the diagnostics are shown as error code. Pass means that the tests have been made without error. If an error is detected, an error code is displayed.

You can also specify how many times the diagnostic tests are performed. Push the **Cycle** side button and then turn the general purpose knob to select the cycle from 1, 3, 10, 100 or Infinite. When you select Infinite, the tests are repeatedly performed, and are not be terminated until you push the **Abort Diagnostic** side button.

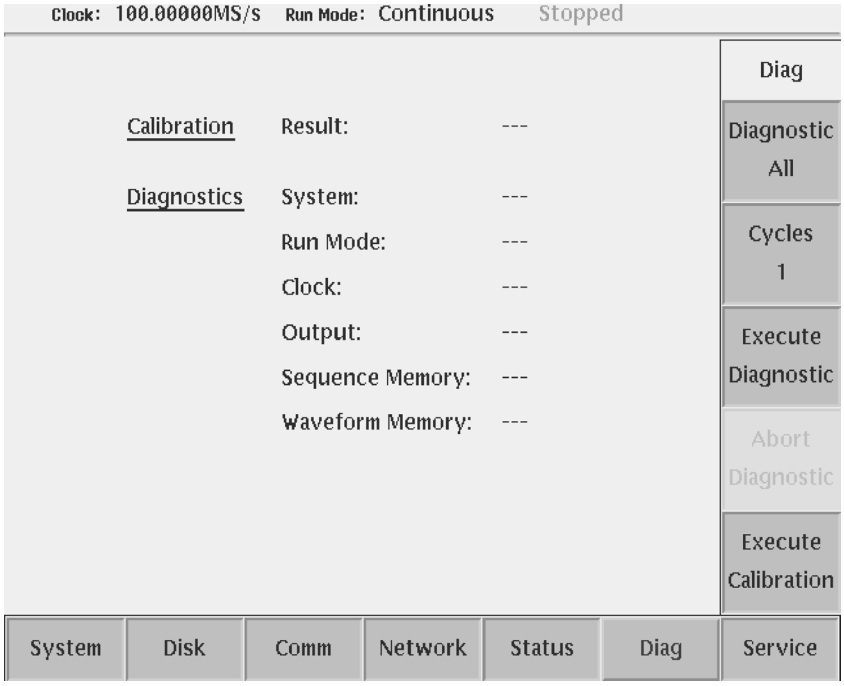


Figure B-1: Diagnostic menu

Do the following to execute all of the AWG710B Arbitrary Waveform Generator diagnostics automatically:

Push the **Execute Diagnostic** side button.

The internal diagnostics do an extensive verification of AWG710B Arbitrary Waveform Generator functions. While this verification progresses, the screen displays the clock icon. When finished, the resulting status appears on the screen.

Verify that no failures are found and reported on–screen. If the diagnostics terminates without error, Pass is displayed instead of the – – –. If a value is displayed, meaning an error is detected, consult a qualified service technician for further assistance.

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Push any bottom or menu button (other than UTILITY) to exit the diagnostic screen.

Calibration

The instrument includes internal calibration routines that check electrical characteristics such as offset, attenuations and filters. Perform calibration to adjust internal calibration constants as necessary. This procedure describes how to do the internal calibration.

Equipment required	None
Prerequisites	Power on the instrument and allow a 20 minute warmup period at an ambient temperature between +20° C and +30° C before doing this procedure.

Confirm that there is no output being performed by verifying that the RUN LED is not on. If the LED is on, push the **RUN** button to turn it off.

NOTE. *Some calibration items may fail if you start calibration while output is being performed.*

Do the following steps to verify that the internal adjustments have passed:

1. Push **UTILITY** (front–panel)→**Diag** (bottom)→ **Execute Calibration** (side).

   This executes the AWG710B Arbitrary Waveform Generator calibration routines automatically.

The internal calibration does an extensive verification of proper AWG710B Arbitrary Waveform Generator functions. While this verification progresses, the message box displaying *Executing Calibration* appear on screen. When finished, the resulting status will appear in the message box as shown in Figure B-2.

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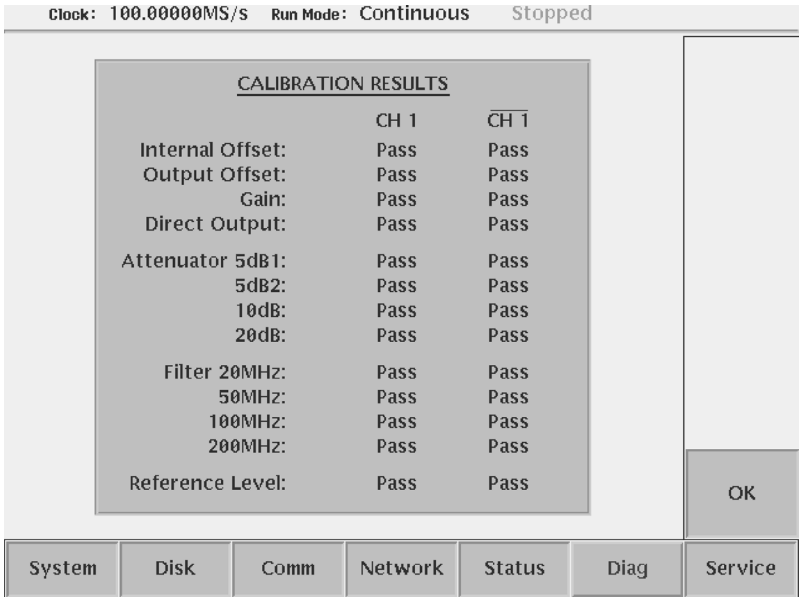


Figure B-2: Calibration result message box (except option 02)

Verify that no failures are found and reported in the message box. If the calibration displays Fail as the result, consult a qualified service technician for further assistance.

2. Push the **OK** side button and then any bottom or menu button (other than the **UTILITY**) to exit the dialog screen.

NOTE. *The calibration data in the memory may be lost if the instrument is powered off while the calibration is executed,*

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Performance Tests

This section contains a collection of procedures for checking that the AWG710B Arbitrary Waveform Generator performs as warranted.

The procedures are arranged in eight logical groupings, presented in the following order:

Table B-1: Performance test items

Titles	See (performance verification)	Test items	See (specifications)
Operating mode tests	Page B-13	Continuous, Triggered, and Gated mode normality	Page A-2
Amplitude and offset accuracy tests (normal out)	Page B-19	Amplitude accuracy, and DC offset accuracy	Page A-4
Amplitude, DC offset and rise time accuracy tests (direct DA out)	Page B-23	Amplitude accuracy, DC offset accuracy and Rise time accuracy	Page A-4
Amplitude, DC offset and Rise time accuracy test (Option2)	Page B-27	Amplitude accuracy, DC offset accuracy and Rise time accuracy	Page A-4
Pulse response tests (normal out)	Page B-31	Rise time accuracy	Page A-4
Trigger input tests	Page B-33	Trigger level accuracy, and Trigger function normality	
Event input and enhanced mode tests	Page B-37	External event input function normality, and Event mode normality	
External Clock input and VCO Out tests (AWG710B only)	Page B-37	External Clock input function normality, and VCO Out normality	Page A-6, A-18
VCO Out frequency and 10 MHz reference input tests (AWG710B only)	Page B-48	VCO Out frequency and Reference input normality accuracy	Page A-3
Marker output tests	Page B-50	Marker output level accuracy	Page A-5
Synchronous operation tests (AWG710B only)	Page B-50	Synchronous operation normality	Page A-5

The performance tests check all of the characteristics that are designated as checked in *Appendix A:Specifications.* (The characteristic items that must be checked are listed with the check mark (✓) in *Appendix A: Specifications*).

NOTE. *These procedures extend the confidence level provided by the basic procedures described on page B-2. The basic procedures should be done first, and then these procedures performed if desired.*

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Prerequisites

The tests in this section comprise an extensive, valid confirmation of performance and functionality when the following requirements are met:

- The cabinet must be installed on the instrument.
- You must have performed and passed the procedures under *Self Tests,* found on page B-2.
- The waveform generator must have been recently adjusted at an ambient temperature between +20° C and +30° C, must have been operating for a warm–up period of at least 20 minutes, and must be operating at an ambient temperature between +10° C and +40° C.

Refer to *Conventions* on page B-1 for more information.

Equipment Required

These procedures use external, traceable signal sources to directly check warranted characteristics. Table B-2 lists the required equipment used to complete the performance tests.

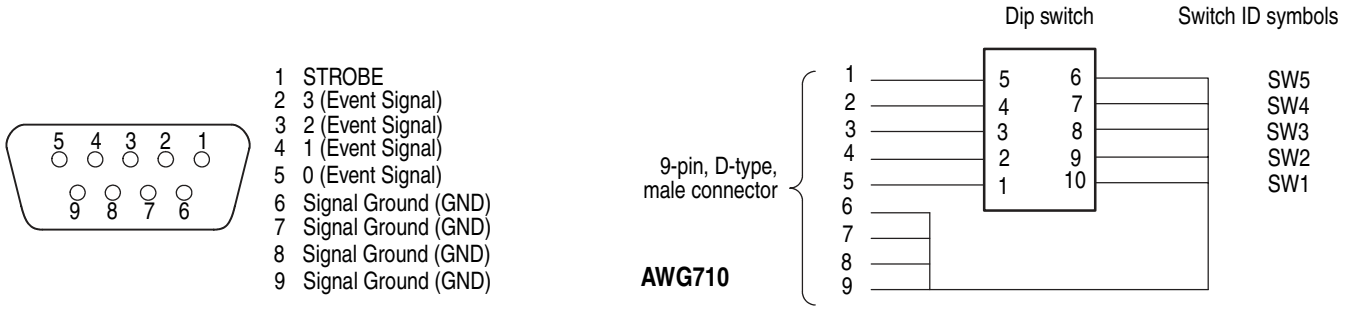
Table B-2: Test equipment

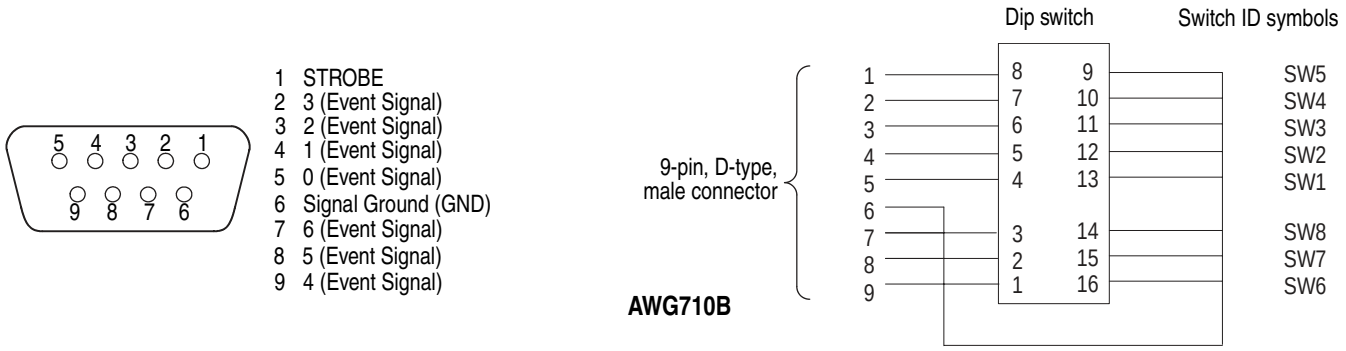
Item number and description	Minimum requirements	Example (recommended)	Purpose
1. Frequency Counter (for AWG710B)	1 MHz to 3 GHz, Accuracy: < 0.2 ppm	Anritsu MF1603A	Checks reference input. VCO Out test
1. Frequency Counter (for AWG710)	1 MHz to 100 MHz, Accuracy: < 0.2 ppm	Anritsu MF1603A	Checks reference input. VCO Out test
2. Digital multi meter	DC volts range: 0.05 V to 10 V, Accuracy: ±0.1 %	Fluke 8842A	Measures voltage. Used in multiple procedures.
3. Oscilloscope	Bandwidth: > 500 MHz, 1 MΩ and 50 Ω inputs	Tektronix TDS784D	Checks output signals. Used in multiple procedures.
4. Oscilloscope	Bandwidth: > 6 GHz, Rise time: < 58.3 ps, 50 Ω input	Tektronix TDS820	Checks pulse response.
5. Function Generator	Output voltage: -5 V to +5 V, Frequency accuracy: < 0.01 %	Tektronix AFG310	Generates external input signals. Used in multiple input signal test procedures.
5. Signal Generator (for AWG710B)	Output voltage: -5 V to +5 V, Frequency accuracy: < 0.01 %	Agilent 8648B	Generates external input signals. Used in multiple input signal test procedures.
6. SMA Coaxial Cable (4 required:for AWG710B)	50 Ω, male to male SMA connectors	Tektronix part number 174–1427–00	Signal interconnection
7. BNC Coaxial Cable (3 required)	50 Ω, male to male BNC connectors	Tektronix part number 012–0482–00	Signal interconnection
8. Adapter (2 required)	SMA (male) to BNC (female), 50 Ω	Tektronix part number 015–0554–00	Signal interconnection
9. Adapter	SMA (female) to BNC (male), 50 Ω	Tektronix part number 015–0572–00	Signal interconnection

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Table B-2: Test equipment (cont.)

Item number and description	Minimum requirements	Example (recommended)	Purpose
10. Adapter	SMA (female) to N(male), 50 Ω	Tektronix part number SMA(fe)-SMA(fe)015–101 2–00 + SMA(ma)-N(ma) 015-0369-00	Signal interconnection
11. BNC–T Connector	BNC (male) to BNC (female) to BNC (female)	Tektronix part number 103–0030–00	Signal interconnection
12. Dual–Banana Connector	BNC (female) to dual banana	Tektronix part number 103–0090–00	Signal interconnection
13. SMA Terminator (2 required)	50 Ω, SMA (male)	Tektronix part number 015–1022–01	Signal termination
14. Precision Terminator	50 Ω, 0.1 %, BNC	Tektronix part number 011–0129–00	Signal termination
15. Performance check disks	Must use example listed	Supplied with the product, Tektronix part number 062–A273–00 for AWG710 063-3721-00 for AWG710B	Used to provide waveform files.
16. Ground closure (loopback cable) with 9–pin, D–type connector		Custom, See Figure B-3.	Used for event mode test.





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Figure B-3: EVENT IN connector pins and signals and ground closure connector

Loading Files

The following steps explain how to load files from the Performance Check/Adjustment disk into waveform memory and/or sequence memory.

1. Insert the disk into the AWG710B Arbitrary Waveform Generator floppy disk drive.
2. Select **SETUP** (front)→**Waveform/Sequence** (bottom)→**Load...** (side)→**Drive...** (side).

   The Select Drive dialog box appears as show in Figure B-4.

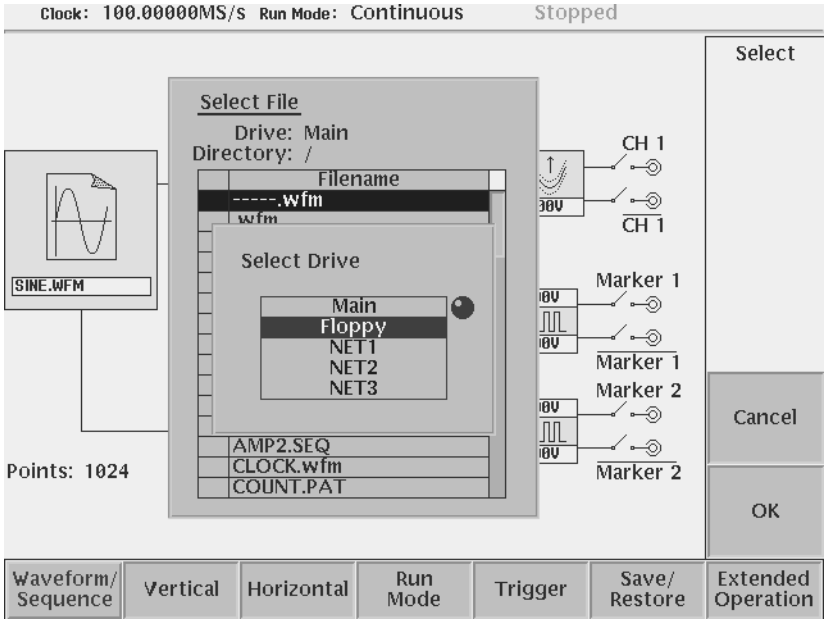


Figure B-4: Loading file; selecting storage drive

3. Select **Floppy** from the dialog box with the general purpose knob, and then push the **OK** side button.

   The Select Drive dialog box disappears, and the files in the floppy disk are listed on the Select File dialog box.
4. Use the general purpose knob to select a file to be loaded from the dialog box, and then push the **OK** side button.

   The waveform or sequence you selected is loaded into the instrument, and the instrument is also setup with the parameters stored in that file.

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5. Remove the floppy disk from the floppy drive if the floppy disk is no longer needed.
6. Push any bottom button or menu button to exit the menu.

NOTE. *The floppy disk file list displayed on the screen does not automatically update when you replace the diskette with another diskette. To update the file list, reselect the floppy disk drive.*

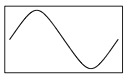
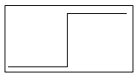
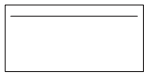
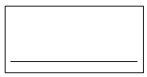
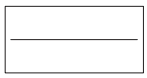
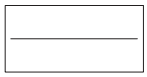
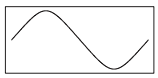
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Performance Check/Adjustment Files

Table B-3 lists the sequence and waveform files on the Performance Check/Adjustment disk that are used in these performance tests, the AWG710B Arbitrary Waveform Generator front–panel settings that each file sets up, and the performance test that uses each file.

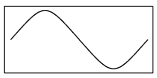
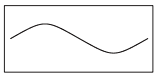
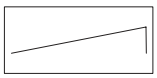
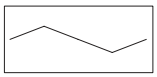
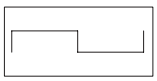
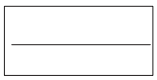
NOTE. *The files on the Performance Check disk are locked (the files are marked by the icon in the file list), so the data in these files cannot be changed unless the lock is opened.*

Table B-3: Waveforms and sequences in performance check disk

No.	File name	EDIT menu		SETUP menu				Marker setup	Usage
		Form	Points	Clock	Filter	Ampl	Offset		
1	MODE.WFM		1000	4 GHz	Through	1 V	0 V	Marker 1,2: 0 to 499: High, 500 to 999: Low	Run mode,Trigger level, Internal trigger accuracy
2	PULSE.WFM		1000	100 MHz	Through	1 V	0 V		Pulse response
3	AMP1.SEQ								Amplitude accuracy (Normal out), Marker
4	AMP2.SEQ								Amplitude accuracy (Direct out)
5	DC_P.WFM (AMPx.SEQ) [1]		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
6	DC_M.WFM (AMPx.SEQ) [1]		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
7	DC0.WFM (AMP2.SEQ)		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
8	OFFSET.WFM		1000	100 MHz	Through	20 mV	0 V		Offset accuracy
9	TRIG.WFM		1000	1 MHz	Through	1 V	0 V		Trigger input
10	PT_EVENT7.SEQ (for AWG710B)								Event input
11	PT_STROB7.SEQ (for AWG710B)								Event input

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Table B-3: Waveforms and sequences in performance check disk (cont.)

No.	File name	EDIT menu		SETUP menu				Marker setup	Usage
		Form	Points	Clock	Filter	Ampl	Offset		
12	S1024.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
13	S1024H.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
14	R1024H.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
15	T1024H.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
16	Q1024H.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
17	NULL1024.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input

[1] **The AMPx.SEQ represents AMP1.SEQ and AMP2.SEQ.**

[2] **The PT_xxxxx.SEQ represents PT_EVENT7.SEQ and PT_STROB7.SEQ**

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Operating Mode Tests

The following procedures verify the operation of the Cont, Triggered and Gated modes.

NOTE. *When you output signal from the CH1 or $\overline{CH1}$ OUTPUT, check that the other OUTPUT ($\overline{CH1}$ or CH1) LED is off.*
If the other OUTPUT LED is on, push the $\overline{CH1}$ or CH1 OUT button to turn off the output.

Check Cont Mode

Equipment required	A 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter and an oscilloscope (TDS700).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable to connect the AWG710B Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure B-5).

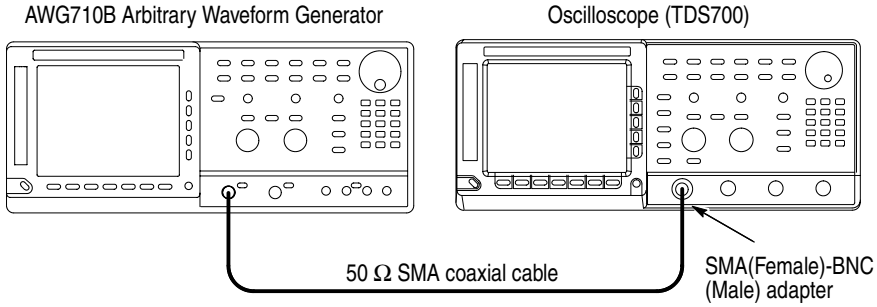


Figure B-5: Cont mode initial test hookup

2. Set the oscilloscope controls as follows:

Vertical CH1
CH1 coupling. . . . . DC
CH1 scale . . . . . 200 mV/div
CH1 input impedance . . . . . 50 Ω
Horizontal
Sweep . . . . . 100 ns/div

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Trigger

Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

Do the following steps to set the AWG710B Arbitrary Waveform Generator controls and to select the waveform file:

1. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
2. Load the MODE.WFM file.

   Refer to *Loading Files* on page B-9 for file loading procedures.
3. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connectors are on.
4. Check that the amplitude of the sine wave displayed on the oscilloscope is 5 vertical divisions and that a waveform of approximately one cycle per 2.5 horizontal divisions is displayed.

Check Triggered Mode

The following table lists the equipment and prerequisites required to check the Triggered mode.

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter, a BNC–T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS700).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable and a BNC–T adapter to connect the function generator output connector to the AWG710B Arbitrary Waveform Generator TRIG IN connector. Refer to Figure B-6.
2. Connect a second 50 Ω BNC coaxial cable to the BNC–T adapter. Connect the opposite end of the coaxial cable to the oscilloscope CH2 input.
3. Use a 50 Ω SMA coaxial cable and SMA(Fe)–BNC(Ma) adapter to connect the AWG710B Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector.

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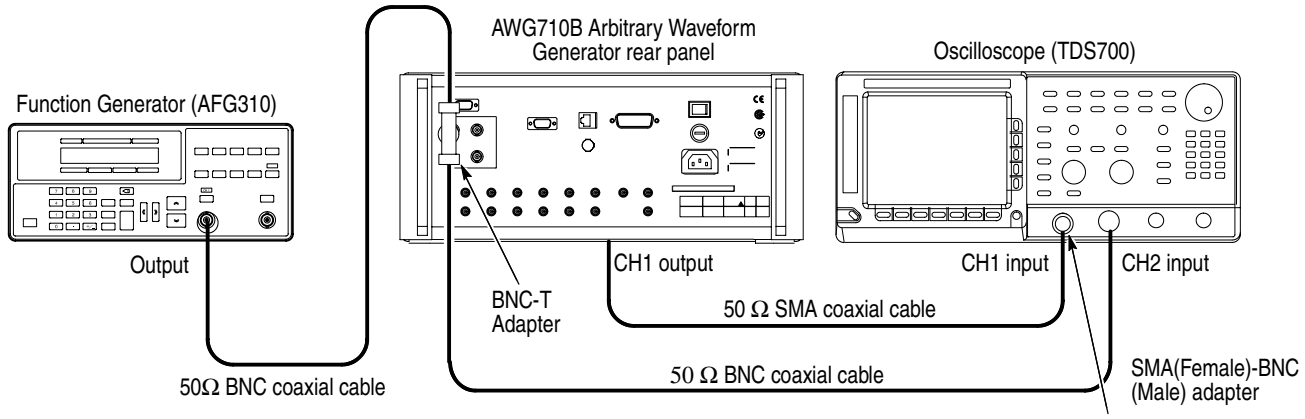


Figure B-6: Triggered mode initial test hookup

4. Set the oscilloscope controls as follows:

VerticalCH1 and CH2	
CH1 and CH2 coupling	DC
CH1 scale	500 mV/div
CH2 scale	2 V/div
CH1 input impedance	50 Ω
CH2 input impedance	1 MΩ
Horizontal	
Sweep	200 ns/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	NORMAL

5. Set the function generator (AFG310) controls as follows:

Function	Square
‘Mode	Continuous
Parameters	
Frequency	1 MHz
Amplitude	2.0 V into 50 Ω (4.0 V into 1 MΩ)
Offset	1.0 V into 50 Ω (2.0 V into 1 MΩ)
Output	Off

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6. Follow the substeps below to set the AWG710B Arbitrary Waveform Generator controls and to select the waveform file:

   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

   b. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Triggered** (side)

   c. Load the MODE.WFM file.

   Refer to *Loading Files* on page B-9 for file loading procedures.

   d. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connectors are on.

   e. Push the **FORCE TRIGGER** button.

   Verify that the oscilloscope displays a one–cycle sine wave when the FORCE TRIGGER button is pushed. You may need to adjust the horizontal position control to see the signal.

7. Follow the substeps below to check the triggered mode with external triggering:

   a. Turn on the function generator output.

   b. Verify that the oscilloscope displays a one–cycle sine wave for each trigger supplied by the function generator. See Figure B-7.

   Retain the test hookup.

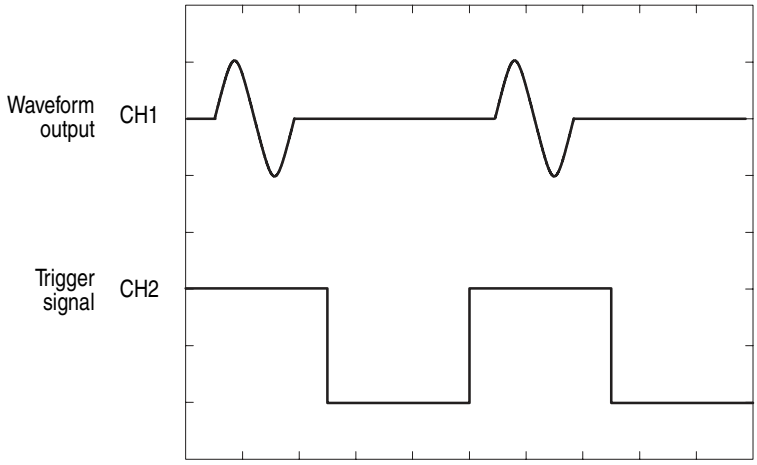


Figure B-7: Relationship between trigger signal and waveform output

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Check Gated Mode

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter, a BNC–T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS700).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

1. Set the oscilloscope controls as follows:

Vertical	CH1 and CH2
CH1 and CH2 coupling	DC
CH1 scale	500 mV/div
CH2 scale	2 V/div
CH1 input impedance	50 Ω
CH2 input impedance	1 MΩ
Horizontal	
Sweep	20 µs/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	100 mV
Mode	NORMAL

2. Set the function generator (AFG310) controls as follows:

Function	Square
Mode	Continuous
Parameters	
Frequency	10.1 kHz
Amplitude	2.0 V into 50 Ω (4.0 V into 1 MΩ)
Offset	1.0 V into 50 Ω (2.0 V into 1 MΩ)
Output	Off

3. Follow the substeps below to set the AWG710B Arbitrary Waveform Generator controls and to select the waveform file:

a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

b. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Gated** (side).

c. Load the MODE.WFM file.

Refer to *Loading Files* on page B-9 for file loading procedures.

d. Push **HORIZONTAL MENU** (front–panel)→ **Clock** (side).

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e. Push **1**, **0**, **0** and **M** (SHIFT+7) keys in this order or turn the general purpose knob to set the internal clock frequency to 100 MHz.

f. Push the **RUN** and **CH1** output buttons.

The LEDs above the **RUN** button and **CH1** output connector are on.

g. Push the **FORCE TRIGGER** button.

Verify that the oscilloscope displays sine waves while the FORCE TRIGGER button is pushed and that the output stops when the Force Trigger button is released.

4. Follow the substeps below to check the gated mode with the gate signal:

a. Set the oscilloscope trigger source to CH2 and change the trigger level to 1 V.

b. Turn on the function generator output.

c. Verify that the oscilloscope displays sine waves while the function generator gate signal amplitude is High level. See Figure B-8.

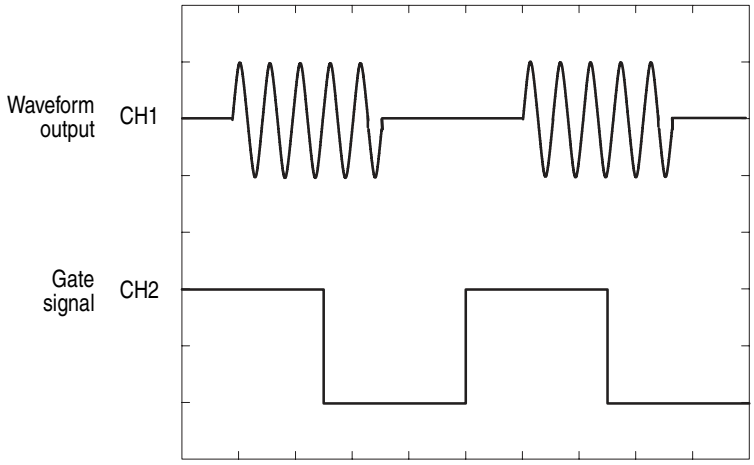


Figure B-8: Relationship between gate signal and waveform output

d. Push **SETUP** (front–panel)→**Trigger** (bottom)→**Negative** (side).

This changes the AWG710B Arbitrary Waveform Generator trigger polarity to negative.

5. Verify that the oscilloscope displays sine waves while the function generator gate signal amplitude is Low level.

6. Turn off the function generator output and disconnect from the oscilloscope.

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Amplitude and Offset Accuracy Tests (Normal Out), (except option 02)

These procedures check the accuracy of the amplitude and offset outputs of the AWG710B Arbitrary Waveform Generator.

NOTE. *The amplitude and offset accuracy checks are structured as a continuous test. The next test uses the control settings from the previous test and uses the next step in the sequence file.*

NOTE. *When you output signal from the $\overline{CH1}$ or CH1 OUTPUT, check that the other OUTPUT ($\overline{CH1}$ or CH1) LED is off.*
If the other OUTPUT LED is on, push the $\overline{CH1}$ or CH1 OUT button to turn off the output.

Check Amplitude Accuracy

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, a SMA(Ma)–BNC(Fe) adapters, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, a SMA(Ma)–BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC–to–dual banana adapter to connect the AWG710B Arbitrary Waveform Generator CH1 output to the DMM input connector (see Figure B-9).

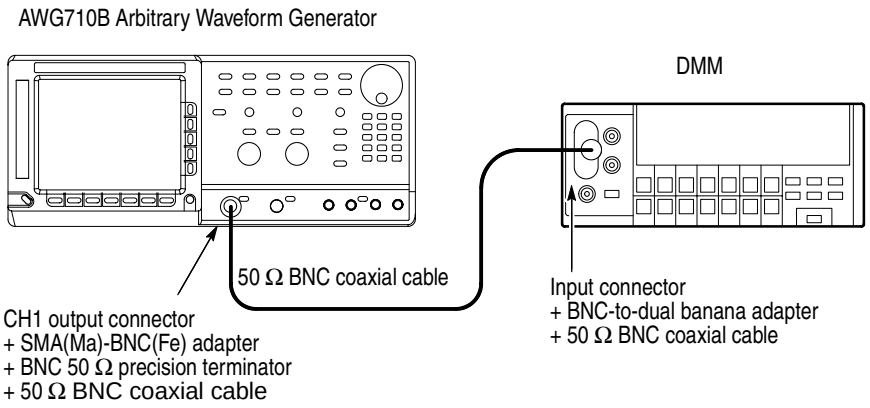


Figure B-9: Amplitude accuracy initial test hookup

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2. Set the DMM controls as follows:

Mode	VDC
Range	Auto
Input	Front

3. Follow the substeps below to set the AWG710B Arbitrary Waveform Generator controls and to select the sequence file:

   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

   b. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side).

   The AWG710B Arbitrary Waveform Generator is set to enhanced mode.

   c. Load the AMP1.SEQ file.

   Refer to *Loading Files* on page B-9 for file loading procedures.

4. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connector are on.

5. Do the following substeps to set the AWG710B Arbitrary Waveform Generator amplitude and confirm the offset setting:

   a. Push **VERTICAL MENU** (front–panel)→**Amplitude** (side).

   b. Push **0, ., 0, 2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.020 V.

   c. Verify that the offset setting display on the Offset side button is 0.000 V.

   If the offset display is not set correctly, push the **Offset** side button, and push **0** and then **ENTER** key.

6. Do the following substeps to check the amplitude accuracy of a 20 mV amplitude setting:

   a. Write the DMM reading as a positive voltage.

   b. Push the **FORCE EVENT** button.

   c. Write the DMM reading as a negative voltage.

   d. Verify that the positive minus negative voltages fall within 20 mV ± 2.4 mV.

   e. Push **0, ., 2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.200 V.

7. Do the following to check the amplitude accuracy of 200 mV amplitude setting:

   a. Push the **FORCE EVENT** button.

   b. Write the DMM reading as a positive voltage.

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c. Push the **FORCE EVENT** button.

d. Write the DMM reading as a negative voltage.

e. Verify that the positive minus negative voltages fall within 200 mV ± 6 mV.

f. Push the **2** and the **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 2 V.

8. Do the following substeps to check the amplitude accuracy of 2 V amplitude setting:

a. Push the **FORCE EVENT** button.

b. Write the DMM reading as a positive voltage.

c. Push the **FORCE EVENT** button.

d. Write the DMM reading as a negative voltage.

e. Check that the positive minus negative voltages fall within 2 V ± 0.042 V.

9. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

a. Push the **CH1** output button.

b. Disconnect the adapter, terminator and cable from the **CH1** output connector.

c. Connect the adapter, terminator, and the cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.

d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

10. Repeat the *Check Amplitude Accuracy* procedure for the AWG710B Arbitrary Waveform Generator $\overline{\text{CH1}}$ beginning on page B-19.

11. Reconnect the test hookup on the $\overline{\text{CH1}}$ output to the CH1 output. Retain the control settings.

Check Offset Accuracy

The following procedure checks the Offset Accuracy.

1. Use the test hookup and settings from previous check on page B-19 and B-19.

2. Follow the substeps below to set the AWG710B Arbitrary Waveform Generator controls and to select the sequence file:

a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

b. Load the OFFSET.WFM file.

Refer to *Loading Files* on page B-9 for file loading procedures.

c. Push **VERTICAL MENU** (front–panel)→**Amplitude** (side).

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d. Push **0, ., 0, 2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.020 V.

3. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connector are on.

4. Do the following substeps to set the AWG710B Arbitrary Waveform Generator offset:

   a. Push the **Offset** side button.

   b. Push **0** and **ENTER** keys in this order.

   c. Verify that the reading on the DMM falls within 0 V ± 10 mV.

   d. Push **0**, **.**, **5** and **ENTER** keys in this order to change the AWG710B Arbitrary Waveform Generator offset to 0.5 V.

   e. Verify that the reading on the DMM falls within 0.5 V ± 0.0175 V.

   f. Push **–**, **0**, **.**, **5** and **ENTER** keys in this order to change the AWG710B Arbitrary Waveform Generator offset to –0.5 V.

   g. Check that the reading on the DMM falls within –0.5 V ± 0.0175 V.

5. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

   a. Push the **CH1** output button.

   b. Disconnect the adapter, terminator and cable from the **CH1** output connector.

   c. Connect the adapter, terminator, and cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.

   d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

6. Repeat the *Check Offset Accuracy* procedure for the AWG710B Arbitrary Waveform Generator $\overline{\text{CH1}}$.

7. Push the **$\overline{\text{CH1}}$** output button to turn off the **$\overline{\text{CH1}}$** LED.

8. Disconnect the test hookup from the $\overline{\text{CH1}}$ output connector.

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Amplitude, Offset Accuracy and Rise Time Tests (Direct DA Out), (except option 02)

These procedures check the accuracy of the WG710B Arbitrary Waveform Generator direct waveform outputs; amplitude and offset.

Check Amplitude and DC Offset

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, an SMA(Ma)–BNC(Fe) adapter, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, an SMA(Ma)–BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC–to–dual banana adapter to connect the AWG710B Arbitrary Waveform Generator **CH1** output to the DMM input connector (see Figure B-10).

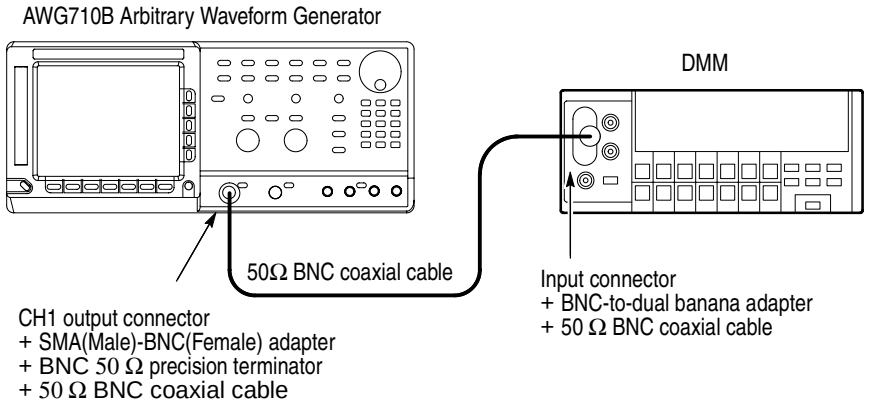


Figure B-10: Direct DA output amplitude accuracy initial test hookup

2. Set the DMM controls as follows:

   Mode . . . . . VDC
   Range . . . . . 2 V
   Input . . . . . Front

3. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

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4. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side).

   The AWG710B Arbitrary Waveform Generator is set to enhanced mode.

5. Push **VERTICAL MENU** (front–panel)→**Output** (side)→**Direct** (side).

6. Load the AMP2.SEQ file.

   Refer to *Loading Files* on page B-9 for file loading procedures.

7. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connector are on.

8. Do the following substeps to check the direct DA amplitude accuracy of 1 V amplitude setting:

   a. Write the DMM reading as a positive voltage.

   b. Push the **FORCE EVENT** button.

   c. Write the DMM reading as a negative voltage.

   d. Verify that the positive minus negative voltages fall within 1.0 V ± 0.022 V.

   e. Push **VERTICAL MENU** (front–panel)→**Amplitude** (side).

   f. Push **0, .,0, 2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.020 V.

9. Do the following to check the direct DA amplitude accuracy of 20 mV amplitude setting:

   a. Push the **FORCE EVENT** button twice.

   b. Write the DMM reading as a positive voltage.

   c. Push the **FORCE EVENT** button.

   d. Write the DMM reading as a negative voltage.

   e. Verify that the positive minus negative voltages fall within 20 mV ± 2.4 mV.

10. Follow the substeps below to check the DC offset:

    a. Push the **FORCE EVENT** button.

    b. Verify that the reading on the DMM falls within 0 V ±10 mV.

11. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

    a. Push the **CH1** output button.

    b. Disconnect the adapter, terminator and cable from the **CH1** output connector.

    c. Connect the adapter, terminator, and cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.

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d. Push the **CH1** output button to turn on the CH1 LED.

e. Push the **FORCE EVENT** button.

12. Repeat steps 8 through step 10 for the AWG710B Arbitrary Waveform Generator CH1.

13. Push the **CH1** output button to turn off the CH1 LED.

14. Push the **RUN** button to turn off the RUN LED.

15. Disconnect the DMM.

Check Pulse Rise Time

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use the 50 Ω SMA coaxial cable to connect the AWG710B Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure B-11).

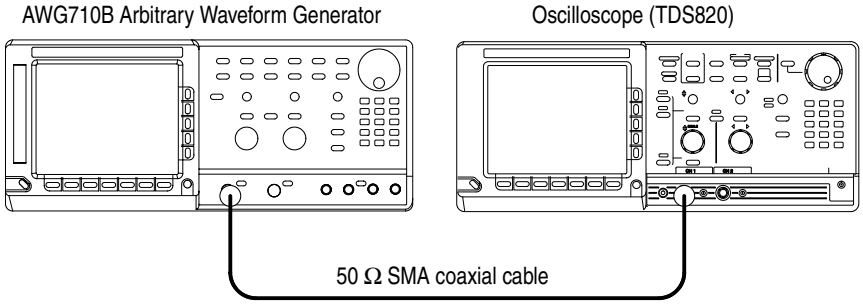


Figure B-11: Direct DA output pulse rise time initial test hookup

2. Set the oscilloscope controls as follows:

Vertical CH1
CH1 coupling. . . . . DC if applicable
CH1 scale . . . . . 100 mV/div
CH1 input impedance . . . . . 50 Ω
Horizontal CH1
Sweep . . . . . 500 ps/div

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Trigger

Source	CH1
Slope	⎍
Level	0 V
Mode	Auto

NOTE. *The pulse rise time tests use the AWG710B Arbitrary Waveform Generators control settings that have been used in the amplitude and DC offset tests. Do not initialize the AWG710B Arbitrary Waveform Generator controls.*

3. Load the PULSE.WFM file.

   Refer to *Loading Files* on page B-9 for file loading procedures.

4. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Continuous** (side).

   The AWG710B Arbitrary Waveform Generator is set to the Continuous mode.

5. Change the AWG710B Arbitrary Waveform Generator controls as follows:

   a. Push **VERTICAL MENU** (bottom)→**Amplitude** (side).

   b. Push **0, ., 5** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.5 V.

   c. Verify that the Direct DA out is set. If not, push **Output** (side)→**Direct** (side).

6. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connectors are on.

7. Verify that the rise time of the pulse waveform displayed on the oscilloscope is equal to or less than 280 ps.

8. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

   a. Push the **CH1** output button.

   b. Disconnect the cable from the CH1 output connector.

   c. Connect the cable to the $\overline{\text{CH1}}$ output connector.

   d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

9. Repeat step 7 to verify the rise time for the AWG710B Arbitrary Waveform Generator $\overline{\text{CH1}}$.

10. Push the **$\overline{\text{CH1}}$** output button to turn off the $\overline{\text{CH1}}$ LED.

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Amplitude, Offset Accuracy and Rise Time Tests (for option 02)

These procedures check the accuracy of the AWG710B Arbitrary Waveform Generator option02 outputs; amplitude and offset.

Check Amplitude and DC Offset

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, an SMA(Ma)–BNC(Fe) adapter, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710B option 02 Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, an SMA(Ma)–BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC–to–dual banana adapter to connect the AWG710B Arbitrary Waveform Generator **CH1** output to the DMM input connector (see Figure B-12).

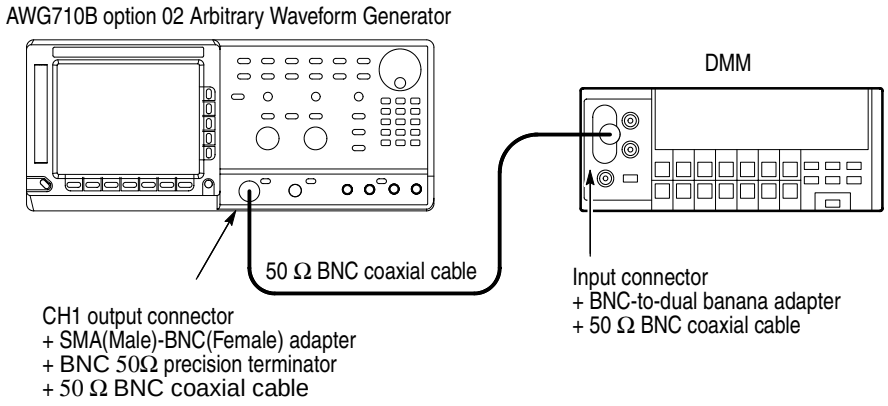


Figure B-12: Option02 output amplitude accuracy initial test hookup

2. Set the DMM controls as follows:

   Mode . . . . . VDC
   Range . . . . . 2 V
   Input . . . . . Front

3. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

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4. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side).

   The AWG710B Arbitrary Waveform Generator is set to enhanced mode.

5. Load the AMP2.SEQ file.

   Refer to *Loading Files* on page B-9 for file loading procedures.

6. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connector are on.

7. Do the following substeps to check the option02 amplitude accuracy of 1 V amplitude setting:

   a. Write the DMM reading as a positive voltage.

   b. Push the **FORCE EVENT** button.

   c. Write the DMM reading as a negative voltage.

   d. Verify that the positive minus negative voltages fall within 1.0 V ± 0.022 V.

   e. Push **VERTICAL MENU** (front–panel)→**Amplitude** (side).

   f. Push **0, . , 5** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.500 V.

8. Do the following to check the option02 amplitude accuracy of 500 mV amplitude setting:

   a. Push the **FORCE EVENT** button twice.

   b. Write the DMM reading as a positive voltage.

   c. Push the **FORCE EVENT** button.

   d. Write the DMM reading as a negative voltage.

   e. Verify that the positive minus negative voltages fall within 500 mV ± 12 mV.

9. Follow the substeps below to check the DC offset:

   a. Push the **FORCE EVENT** button.

   b. Verify that the reading on the DMM falls within 0 V ±10 mV.

10. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

    a. Push the **CH1** output button.

    b. Disconnect the adapter, terminator and cable from the **CH1** output connector.

    c. Connect the adapter, terminator, and cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.

    d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

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e. Push the **FORCE EVENT** button.

11. Repeat steps 7 through step 9 for the AWG710B Arbitrary Waveform Generator $\overline{\text{CH1}}$.

12. Push the **$\overline{\text{CH1}}$** output button to turn off the $\overline{\text{CH1}}$ LED.

13. Push the **RUN** button to turn off the RUN LED.

14. Disconnect the DMM.

Check Pulse Rise Time

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use the 50 Ω SMA coaxial cable to connect the AWG710B Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure B-13).

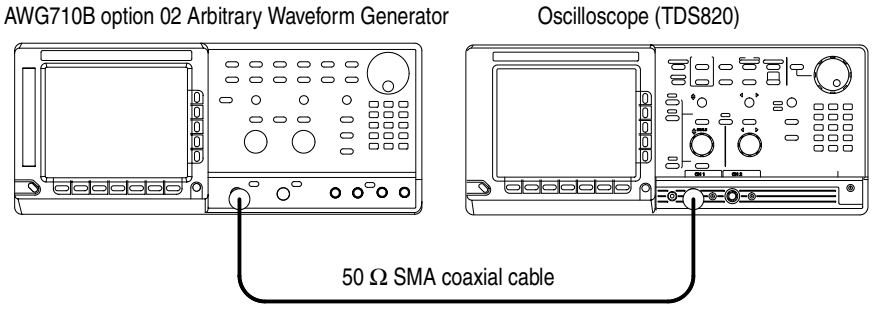


Figure B-13: Optipn02 output pulse rise time initial test hookup

2. Set the oscilloscope controls as follows:

Vertical CH1
CH1 coupling. . . . . DC if applicable
CH1 scale . . . . . 200 mV/div
CH1 input impedance . . . . . 50 Ω
Horizontal
Sweep . . . . . 200 ps/div

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Trigger

Source	CH1
Slope	⎍
Level	0 V
Mode	Auto

NOTE. *The pulse rise time tests use the AWG710B Arbitrary Waveform Generators control settings that have been used in the amplitude and DC offset tests. Do not initialize the AWG710B Arbitrary Waveform Generator controls.*

3. Load the PULSE.WFM file.

   Refer to *Loading Files* on page B-9 for file loading procedures.

4. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Continuous** (side).

   The AWG710B Arbitrary Waveform Generator is set to the Continuous mode.

5. Change the AWG710B Arbitrary Waveform Generator controls as follows:

   a. Push **VERTICAL MENU** (bottom)→**Amplitude** (side).

   b. Push **1** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 1 V.

6. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connectors are on.

7. Verify that the rise time of the pulse waveform displayed on the oscilloscope is equal to or less than 175 ps.

8. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

   a. Push the **CH1** output button.

   b. Disconnect the cable from the CH1 output connector.

   c. Connect the cable to the $\overline{\text{CH1}}$ output connector.

   d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

9. Repeat step 7 to verify the rise time for the AWG710B Arbitrary Waveform Generator $\overline{\text{CH1}}$.

10. Push the **$\overline{\text{CH1}}$** output button to turn off the $\overline{\text{CH1}}$ LED.

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Pulse Response Tests (Normal Out), (except option 02)

This procedure checks the pulse response characteristics of the AWG710B Arbitrary Waveform Generator output waveforms at amplitudes of 1 V.

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use the 50 Ω SMA coaxial cable to connect the AWG710B Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure B-14).

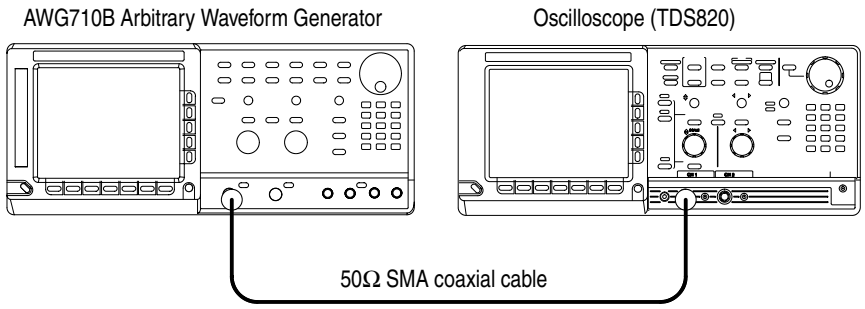


Figure B-14: Pulse response initial test hookup

2. Set the oscilloscope controls as follows:

VerticalCH1
- CH1 coupling . . . . . DC if applicable
- CH1 scale . . . . . 200 mV/div

Horizontal
- Sweep . . . . . 500 ps/div

Trigger
- Source CH1
- Slope . . . . . Positive
- Level . . . . . 0 V
- Mode . . . . . Auto

3. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side) →**OK** (side).

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4. Load the PULSE.WFM file.

   Refer to *Loading Files* on page B-9 for file loading procedures.

5. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connector are on.

6. Verify the pulse response at 1 V amplitude.

   a. Verify that the rise time of the waveform displayed on the oscilloscope from 10% to 90% point is equal to or less than 480 ps.

7. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

   a. Push the **CH1** output button.

   b. Disconnect the cable from the CH1 output connector.

   c. Connect the cable to the $\overline{\text{CH1}}$ output connector.

   d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

8. Repeat the *Check Pulse Response procedure* for the AWG710B Arbitrary Waveform Generator $\overline{\text{CH1}}$.

9. Push the **$\overline{\text{CH1}}$** output button to turn off the **$\overline{\text{CH1}}$ LED.**

10. Disconnect the oscilloscope.

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Trigger Input Tests

These procedures check the trigger level accuracy of the AWG710B Arbitrary Waveform Generator.

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter, a BNC–T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS700).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable and an SMA(Fe)–BNC(Fe) adapter to connect the AWG710B Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector.
2. Use a BNC coaxial cable to connect the function generator to the BNC–T adapter which goes to the Trigger Input on the AWG710B. Connect a 50 Ω BNC coaxial cable to the BNC–T adapter.Connect the opposite end of the BNC cable to the CH2 input on the oscilloscope.

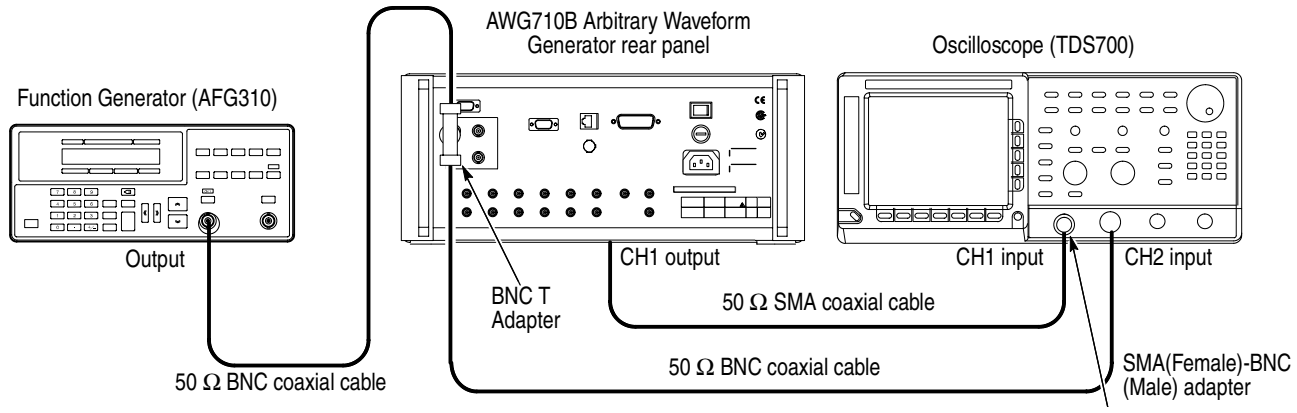


Figure B-15: Trigger input initial test hookup

3. Set the oscilloscope controls as follows:

Vertical	CH1 and CH2
CH1 and CH2 coupling	DC
CH1 scale	500 mV/div
CH2 scale	2 V/div

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CH1 input impedance	50 Ω
CH2 input impedance	1 M Ω
Horizontal	
Sweep	1 ms/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

a. Set the function generator controls as follows:

Function	DC
Mode	Continuous
Output	Off

b. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

c. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Gated** (side).

d. Load the TRIG.WFM file**.**

Refer to *Loading Files* on page B-9 for file loading procedures.

4. Push the **RUN** and **CH1 OUT** buttons.

The LEDs above the RUN button and CH1 output connector are on.

5. Set the trigger level to 5 V by the following substeps below:

a. Push **SETUP** (front–panel)→**Trigger** (bottom)→**Level** (side).

b. Push **5** and **ENTER** keys in this order.

6. Set the trigger input signal level to 4.65 V by the following substeps below:

a. Turn on the function generator output.

b. Select offset by pressing the **OFFSET** button of function generator.

c. Set the DC waveform high level to 4.65 V by using cursor keys.

d. Check that no waveform is displayed on the oscilloscope as shown in Figure B-16.

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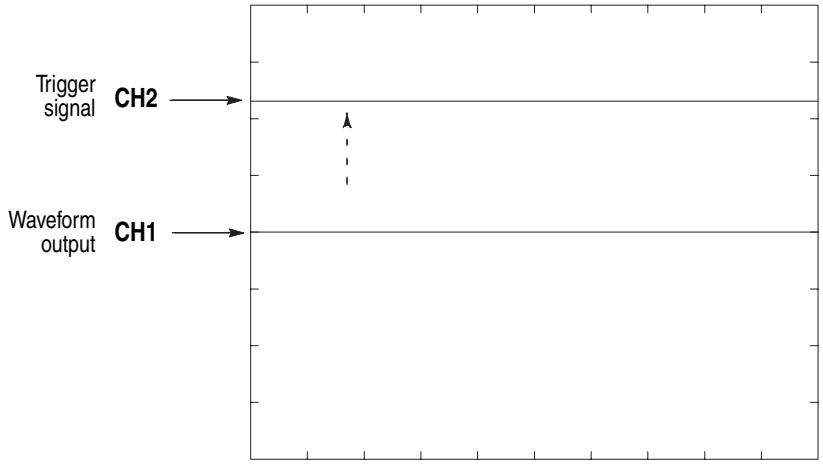


Figure B-16: Trigger signal and waveform output (+5 V check 1)

e. Change the pulse waveform high level to 5.35 V by using cursor keys.

f. Check that sine waves are displayed on the oscilloscope as shown in Figure B-7.

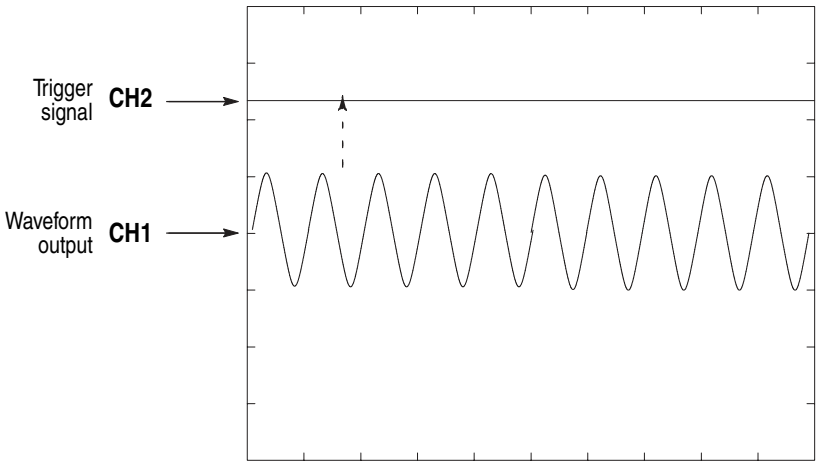


Figure B-17: Trigger signal and waveform output (+5 V check 2)

7. Follow the substeps below to check trigger level accuracy at –5 V:

a. Push **–, 5** and **ENTER** keys in this order.

b. Set the DC waveform low level of function generator to –5.35 V by using cursor keys.

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c. Check that no waveform is being displayed on the oscilloscope as shown in Figure B-18.

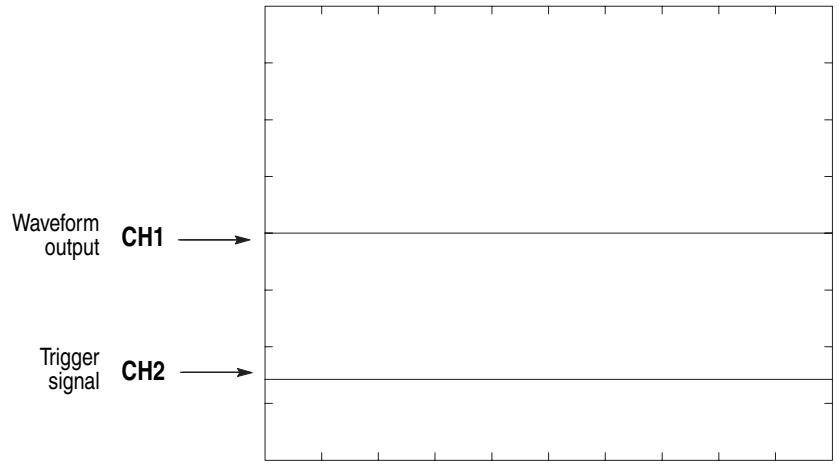


Figure B-18: Trigger signal and waveform output (-5 V check 1)

d. Change the pulse waveform low level of function generator to –4.65 V by using cursor keys.

e. Check that sine waves are displayed on the oscilloscope as shown in Figure B-19.

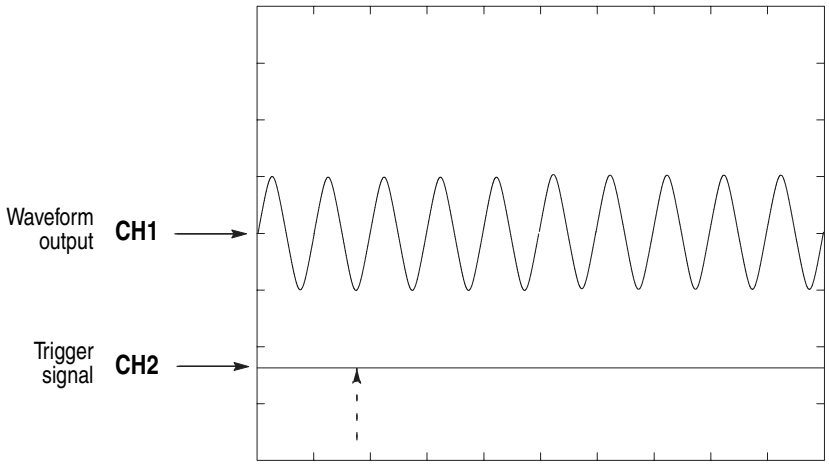


Figure B-19: Trigger signal and waveform output (-5 V check 2)

8. Push the **RUN** button and the CH1 button to turn off the RUN LED.

9. Turn off the function generator output, disconnect the function generator.

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Event Input and Enhanced Mode Tests

These procedures check the event input signals and enhanced mode operation.

NOTE. *The event input check with strobe off and the strobe input check are structured as a continuous test. After* Check Event Input with Strobe Off*, the next test uses the connections and oscilloscope settings from the previous test.*

Check Event Input with Strobe Off

Equipment required	A 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter an oscilloscope (TDS700), and custom–made ground closure. See Figure B-3 for the connections.
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50Ω SMA coaxial cable and a SMA(Fe)–BNC(Fe) adapter to connect the AWG710 Arbitrary Waveform Generator **CH1** output connector to the oscilloscope CH1 input connector (see Figure B-20).

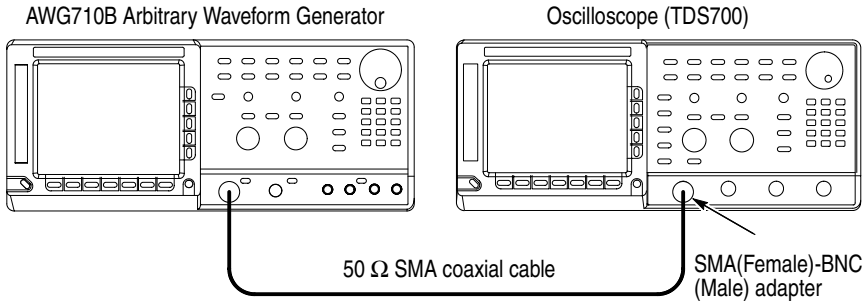


Figure B-20: Event input and enhanced mode initial test hookup

2. Connect the ground closure to the EVENT IN connector on the AWG710B Arbitrary Waveform Generator rear panel.

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3. Set the oscilloscope controls as follows:

Vertical	CH1
CH1 coupling	DC
CH1 scale	200 mV/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	500 ns/div or 400 ns/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

4. Set all the switches of the ground closure to open.

5. Follow the substeps below to set the AWG710B Arbitrary Waveform Generator controls and select the sequence file:

   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

   b. Load the PT_EVENT.SEQ file**.**

   Refer to *Loading Files* on page B-9 for file loading procedures.

   c. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the enhanced mode.

6. Push the **RUN** and **CH1 OUT** buttons.

   The LEDs above the RUN button and CH1 output connector are on.

7. Check the EVENT IN connector pin 0 input:

   a. Verify that a waveform displayed on the oscilloscope has the same amplitude as shown in Figure B-21.

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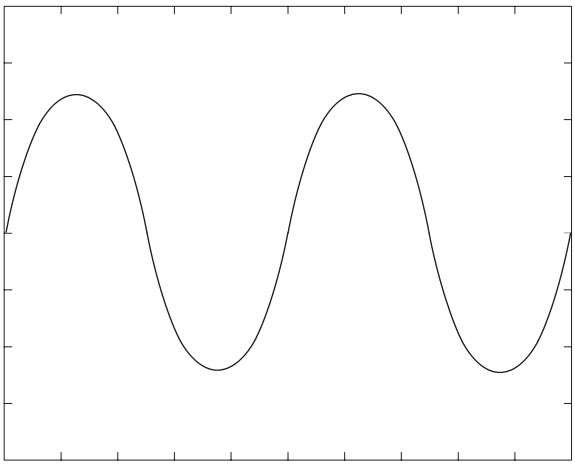


Figure B-21: Waveform while all ground disclosure switches are open

b. Close the SW1 of the ground closure to generate an event signal on the EVENT IN connector pin 0.

c. Verify that the oscilloscope displays the waveform as shown in Figure B-22 and that the waveform amplitude is the half size of Figure B-21.

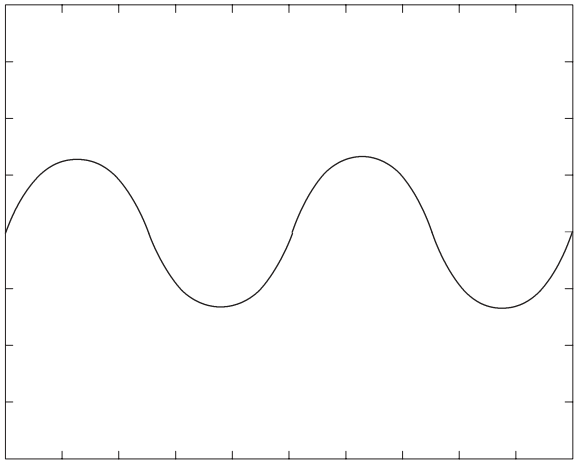


Figure B-22: Waveform output when the SW1 is closed

d. Open SW1 of the ground closure to degenerate the event signal.

e. Verify that the oscilloscope displays the waveform in Figure B-21.

8. Check the EVENT IN connector pin 1 input:

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a. Close SW2 of the ground closure to generate an event signal on the EVENT IN connector pin 1.

b. Verify that the oscilloscope displays the waveform as shown in Figure B-23.

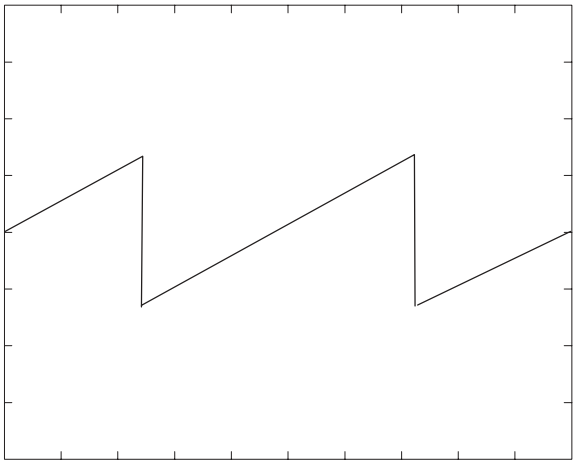


Figure B-23: Waveform output when SW2 is closed

c. Open the SW2 of the ground closure to degenerate the event signal.

d. Verify that the oscilloscope displays the waveform shown in Figure B-21.

9. Check the EVENT IN connector pin 2 input:

a. Close SW3 of the ground closure to generate an event signal on the EVENT IN connector pin 2.

b. Verify that the oscilloscope displays the waveform shown in Figure B-24.

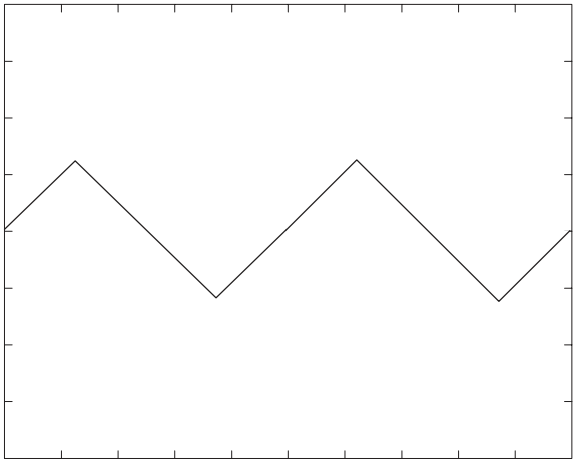


Figure B-24: Waveform output when the SW3 is closed

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c. Open SW3 of the ground closure to degenerate the event signal.

d. Verify that the oscilloscope displays the waveform in Figure B-21.

10. Check the EVENT IN connector pin 3 input:

a. Close the SW4 of the ground closure to generate an event signal on the EVENT IN connector pin 3.

b. Verify that the oscilloscope displays the waveform shown in Figure B-25.

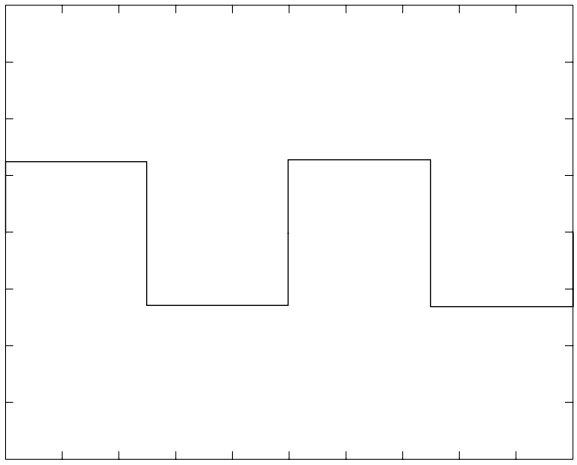


Figure B-25: Waveform output when SW4 is closed

c. Open SW4 of the ground closure to degenerate the event signal.

d. Verify that the oscilloscope displays the waveform in Figure B-21.

11. Check the EVENT IN connector pin 4 input:

a. Close the SW6 of the ground closure to generate an event signal on the EVENT IN connector pin 4.

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b. Verify that the oscilloscope displays the waveform shown in Figure B-26 and that the waveform cycle is the half of Figure B-21.

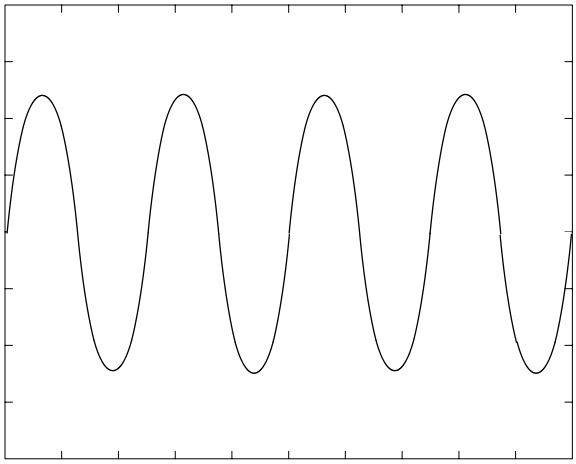


Figure B-26: Waveform output when SW6 is closed

c. Open SW6 of the ground closure to degenerate the event signal.

d. Verify that the oscilloscope displays the waveform in Figure B-21.

12. Check the EVENT IN connector pin 5 input:

a. Close the SW7 of the ground closure to generate an event signal on the EVENT IN connector pin 5.

b. Verify that the oscilloscope displays the waveform shown in Figure B-27.

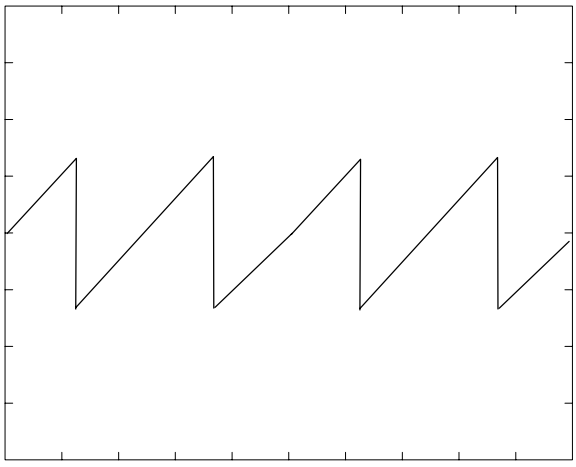


Figure B-27: Waveform output when SW7 is closed

c. Open SW7 of the ground closure to degenerate the event signal.

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d. Verify that the oscilloscope displays the waveform in Figure B-21.

13. Check the EVENT IN connector pin 6 input:

a. Close the SW8of the ground closure to generate an event signal on the EVENT IN connector pin 6.

b. Verify that the oscilloscope displays the waveform shown in Figure B-27.

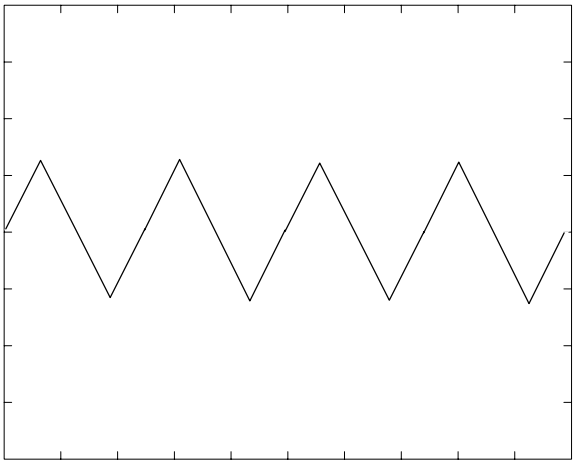


Figure B-28: Waveform output when SW8 is closed

c. Open SW8 of the ground closure to degenerate the event signal.

d. Verify that the oscilloscope displays the waveform in Figure B-21.

14. Retain the test hookup and control settings.

Check Strobe Input

Use the test hookup and oscilloscope settings from previous check.

1. Follow the substeps below to set the AWG710B Arbitrary Waveform Generator controls and select the sequence file:

a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

b. Load the PT_STROB7.SEQ file**.**

Refer to *Loading Files* on page B-9 for file loading procedures.

c. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the run mode to enhanced.

2. Push the **RUN** and **CH1 OUT** buttons.

The LEDs above the RUN button and CH1 output connector are on.

3. Check the EVENT IN connector strobe pin input:

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a. Verify that the waveform displayed on the oscilloscope has the same amplitude as shown in Figure B-29.

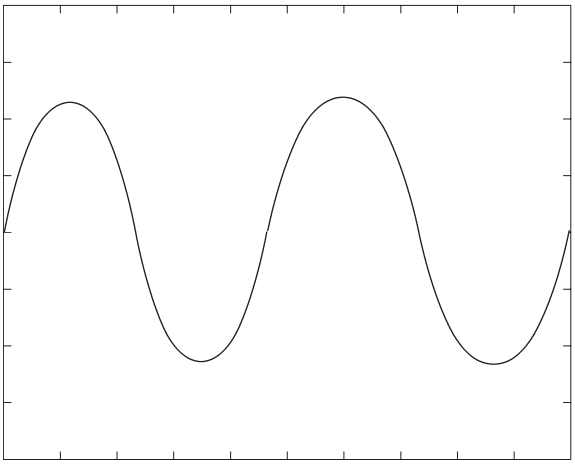


Figure B-29: Initial waveform output

b. Close SW5 of the ground closure to generate an event signal on the EVENT IN connector strobe pin.

c. Verify that the oscilloscope displays the DC waveform as shown in Figure B-30.

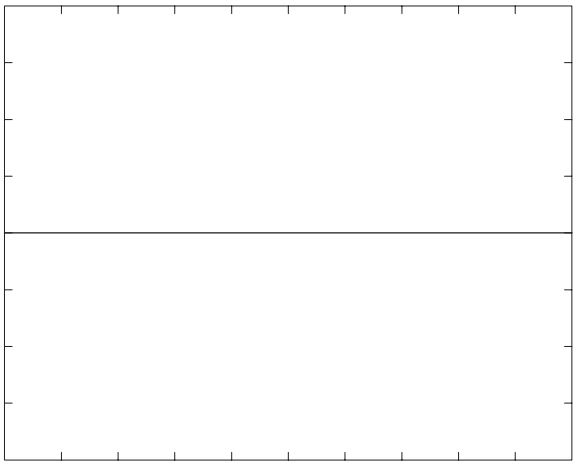


Figure B-30: DC waveform output when the SW5 is closed

d. Open SW5 of the ground closure to degenerate the strobe signal on the EVENT IN connector strobe pin.

e. Verify that the DC waveform is displayed on the oscilloscope.

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f. Close SW5 of the ground closure again.

g. Verify that the oscilloscope displays the waveform as shown in Figure B-29.

4. Push the **CH1 OUT** button to turn off the CH1 LED.
5. Disconnect the oscilloscope and ground closure.

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External Clock Input and VCO Out Output Tests

These procedures check the external clock input function and the VCO output function of the AWG710B Arbitrary Waveform Generator.

Equipment required	Two 50 Ω SMA coaxial cables, a SMA(Fe)–BNC(Ma) adapter, a signal generator, and an oscilloscope (TDS700).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable and an SMA(Fe)–BNC(Fe) adapter to connect the AWG710B Arbitrary Waveform Generator VCO OUT output connector to the oscilloscope CH1 input connector.
2. Use a 50 Ω SMA coaxial cable to connect the AWG710B Arbitrary Waveform Generator EXT CLOCK IN input connector to the signal generator output connector.

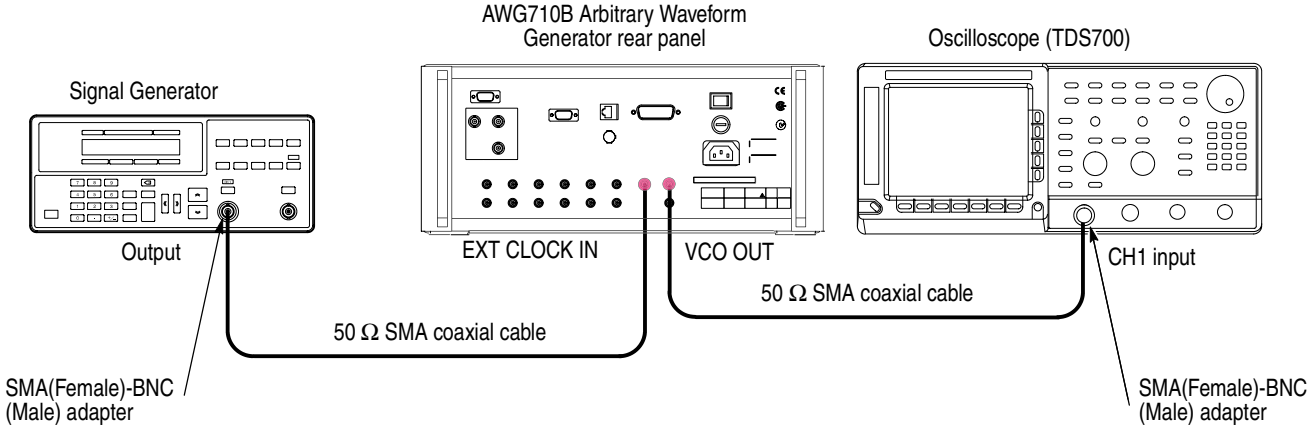


Figure B-31: Trigger input initial test hookup

3. Set the oscilloscope controls as follows:

Vertical CH1
CH1 coupling. . . . . DC
CH1 scale . . . . . 200 mV/div
CH1 input impedance . . . . . 50 Ω
Horizontal
Sweep . . . . . 2 ns/div

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Trigger
- Source CH1
- Coupling . . . . . DC
- Slope . . . . . Positive
- Level . . . . . 0 V
- Mode . . . . . Auto

a. Set the signal generator controls as follows:

Parameter
- Frequency . . . . . 200 MHz
- Amplitude . . . . . 1.0 V (50 Ω)

Output . . . . . On

b. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

c. Load the MODE.WFM file**.**

d. Push **SETUP** (front–panel)→**Horizontal** (bottom)→**Clock Src** (side) →**External**.

Refer to *Loading Files* on page B-9 for file loading procedures.

4. Push the **RUN** and **CH1 OUT** buttons.
5. Check that the LEDs above the RUN button and CH1 output connector are on.
6. Check that about 200.00 MS/s is displayed on the Clock field on the left-hand side of the AWG710B display top end.
7. Check that the amplitude of the square wave displayed on the oscilloscope is approximately 400 mV_{p-p} and the period is approximately 5 ns.
8. Disconnect the cable from the VCO OUT connector and connect the cable to the $\overline{\text{VCO OUT}}$ connector.
9. Check that the amplitude of the square wave displayed on the oscilloscope is approximately 400 mV_{p-p} and the period is approximately 5 ns.
10. Disconnect the cable from the $\overline{\text{VCO OUT}}$ connector and connect the cable to the CH1 OUTPUT connector of the AWG710B.
11. Set the Horizontal sweep of the oscilloscope to 2 µ/s/
12. Check that the period of the sine wave displayed on the oscilloscope is approximately 5 µs.
13. Push the **RUN** button and the CH1 button to turn off the RUN LED.
14. Turn off the function generator output, disconnect the function generator.

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VCO OUT Output Frequency and 10 MHz Reference Input Tests

These procedures check the VCO OUT output frequency and the 10 MHz reference input function of the AWG710B Arbitrary Waveform Generator.

Equipment required	A 50 Ω SMA coaxial cable, A 50 Ω BNC coaxial cable, a SMA(Fe)–BNC(Ma) adapter, a frequency counter, and a function generator.
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable and SMA(Fe)–BNC(Ma) adapter to connect the AWG710B Arbitrary Waveform Generator VCO OUT connector to the input B connector on the frequency counter.
2. Use a 50 Ω BNC coaxial cable to connect the AWG710B Arbitrary Waveform Generator 10 MHz REF IN connector to the function generator output connector (see Figure B-32).

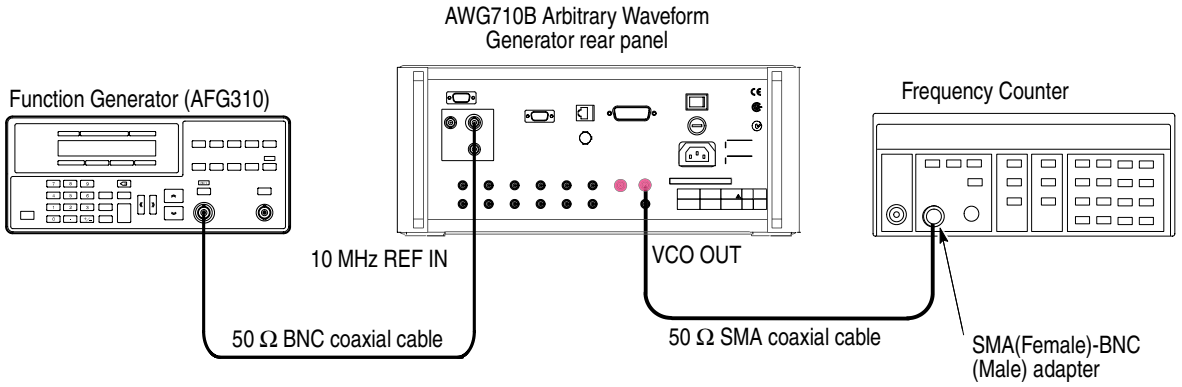


Figure B-32: VCO OUT outputfrequency and 10 MHz reference input initial test hookup

a. Set the frequency counter controls as follows:

INPUT A
Coupling . . . . . AC
FUNCTION . . . . . B FREQ
Gate time . . . . . 0.2 s
Trigger Level . . . . . 0 V

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b. Set the function generator (AFG310) controls:

Function	Square
Mode	Continuous
Parameters	
Frequency	10 MHz
Amplitude	2.0 V into 50 Ω (4.0 V into 1 MΩ)
Offset	0 V
Output	On

Check VCO OUT frequency

1. Follow the substeps below to set the AWG710B Arbitrary Waveform Generator controls and select the waveform file:

   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

   b. Load the MODE.WFM file.

   Refer to *Loading Files* on page B-9 for file loading procedures.

   c. Push **HORIZONTAL MENU** (front–panel)→**Clock** (side).

   d. Push **2, ., 5** and **G** (SHIFT+CLR) keys in this order or turn the general purpose knob to set the internal clock frequency to 2.5 GHz.

2. Push the **RUN** button.

   The LED above the RUN button is on.

3. Verify that the frequency counter reading is 2.5 GHz ± 2.5 kHz (using internal reference clock).

4. Retain the test hookup.

Check 10MHz Reference Input

5. Push **HORIZONTAL MENU** (front–panel)→**Clock Ref** (side) so that the AWG710B Arbitrary Waveform Generator reference clock is set to External.

6. Verify that the frequency counter reading is approximately 2.50 GHz (using external reference clock).

7. Change the function generator controls as follows:

Frequency	9.9 MHz

8. Check that the frequency counter reading is approximately 2.475 GHz.

9. Turn the function generator output off and disconnect the function generator and frequency counter.

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Marker Output Tests

These procedures check the accuracy of the AWG710B Arbitrary Waveform Generator marker output level.

NOTE. *Connect a 50Ω SMA terminator to the inverted marker output connector during the marker output tests.*

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, a SMA(Ma)–BNC(Fe) adapters, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, a SMA(Ma)–BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC–to–dual banana adapter to connect the AWG710B Arbitrary Waveform Generator MARKER 1 OUT to the DMM input connector (see Figure B-33).

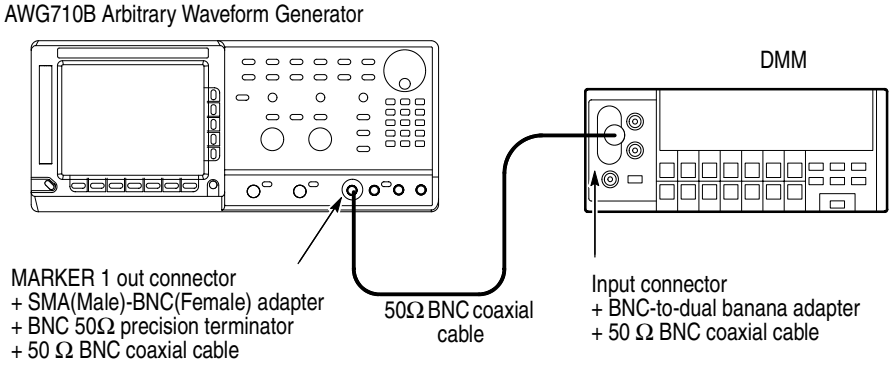


Figure B-33: Marker output initial test hookup

2. Set the DMM controls as follows:

Mode	VDC
Range	Auto
Input	Front

3. Follow the substeps below to set the AWG710B Arbitrary Waveform Generator controls and to select the sequence file:

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a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

b. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side).

The AWG710B Arbitrary Waveform Generator is set to enhanced mode.

c. Load the AMP1.SEQ file.

Refer to *Loading Files* on page B-9 for file loading procedures.

4. Push the **RUN** button and **ALL MARKER OUT ON/OFF** button.

The LEDs above the RUN button and ALL MARKER OUT ON/OFF is on.

5. Do the following substeps to set the AWG710B Arbitrary Waveform Generator marker output high level setting:

a. Push **VERTICAL MENU** (front–panel)→**Marker...** (side)→**Marker 1 High Level** (side).

b. Push **2, ., 4, 5** and **ENTER** keys in this order or turn the general purpose knob to set the marker level to 2.45 V.

c. Verify that the marker 1 high level reading on the DMM screen falls within 2.2275 V through 2.6725 V.

d. Push the **FORCE EVENT** button.

6. Do the following substeps to set the AWG710B Arbitrary Waveform Generator marker output low level setting:

a. Push **Marker 1 Low Level** side button.

b. Push **-, 2, ., 0** and **ENTER** keys in this order or turn the general purpose knob to set the marker level to -2.0 V.

c. Verify that the marker 1 low level reading on the DMM screen falls within -2.2 V through -1.8 V.

d. Push the **FORCE EVENT** button.

7. Do the following substeps to change the connection to check the $\overline{\text{MARKER1}}$:

a. Disconnect the 50 Ω precision terminator from the $\overline{\text{MARKER1}}$ OUT connector.

b. Disconnect the cable (with SMA(Ma)-BNC(Fe) adapter and BNC 50 Ω terminator) from MARKER 1 OUT connector.

c. Connect the 50 Ω precision terminator to the MARKER 1 OUT (removed in step a).

d. Connect the adapter, terminator, and the cable (removed in step b) to the $\overline{\text{MARKER1}}$ OUT connector.

8. Press Force Event where needed.

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9. Repeat steps 5 and 6 for the AWG710B Arbitrary Waveform Generator MARKER1 OUT.
10. Repeat steps 5 through 8 for MARKER 2 OUT and MARKER2 OUT.
11. Disconnect the DMM.

Synchronous Operation Tests

These procedures check the signal path for the Synchronous Operation of the AWG710B Arbitrary Waveform Generator.

Equipment required	Four 50 Ω SMA C coaxial cables (P/N: 174-1427-00).
Prerequisites	The AWG710B Arbitrary Waveform Generator must meet the prerequisites listed on page B-7.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use four 50 Ω SMA coaxial cables to connect the T IN connector to the T OUT1 connector, the T IN connector to the T OUT1 connector, the C IN connector to the C OUT1 connector, and the C IN connector to the C OUT1 connector(see Figure B-34).

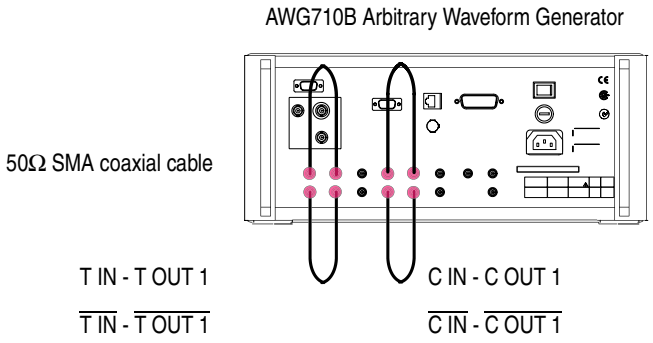


Figure B-34: Synchronous operation test hookup

2. Follow the substeps below to set the AWG710B Arbitrary Waveform Generator controls and to select the sequence file:
   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

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b. Push **SETUP** (front–panel)→**Extended Operation** (bottom)→**Sync - Master** (side).

c. Push **Connect** (bottom)→**Execute Trig Timing Calibration** (side).

3. Check that Pass is displayed being displayed on the Trigger Timing Cal. field at the lower left of the AWG710B screen.

4. Change the cable connection.

a. Disconnect the cable from the T OUT1 connector and connect it to the T OUT2 connector.

b. Disconnect the cable from the $\overline{\text{T OUT1}}$ connector and connect it to the $\overline{\text{T OUT2}}$ connector.

c. Disconnect the cable from the C OUT1 connector and connect it to the T OUT2 connector.

d. Disconnect the cable from the $\overline{\text{C OUT1}}$ connector and connect it to the $\overline{\text{T OUT2}}$ connector.

5. Push **Execute Trig Timing Calibration** (side).

6. Check that Pass is displayed being displayed on the Trigger Timing Cal. field at the lower left of the AWG710B screen.

7. Disconnect the four SMA cables.

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Appendix B: Performance Verification (AWG710)

Two types of Performance Verification procedures can be performed on this product: *Self Tests* and *Performance Tests*. You may not need to perform all of these procedures, depending on what you want to accomplish.

- Verify that the AWG710 Arbitrary Waveform Generator is operating correctly by running the self tests which begin on page B-56.

  Advantages: These procedures require minimal time to perform, require no additional equipment, and test the internal hardware of the AWG710 Arbitrary Waveform Generator.

- If a more extensive confirmation of performance is desired, complete the self test, and then do the performance test beginning on page B-60.

  Advantages: These procedures add direct checking of warranted specifications. They require more time to perform and suitable test equipment is required. (Refer to *Equipment Required* on page B-61).

Conventions

Throughout these procedures the following conventions apply:

- Each test procedure uses the following general format:

  Title of Test

  Equipment Required

  Prerequisites

  Procedure

- Each procedure consists of as many steps, substeps, and subparts as required to do the test. Steps, substeps, and subparts are sequenced as follows:

  1. First Step
     a. First Substep
        - First Subpart
        - Second Subpart

     b. Second Substep
  2. Second Step

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- Instructions for menu selection use the following format: **front–panel BUTTON→Main Menu Button→Side Menu Button**. For example, Push **UTILITY→System→Reset to Factory→OK**
- The name of the button or knob appears in boldface type:

  Push **EDIT**; then **Drive...**, push **Floppy** side button and use the knob to select SINE.WFM from the file list.

Self Tests

The *Self Tests* use internal routines to confirm basic functionality and proper adjustment. No test equipment is required to do these test procedures.

The self tests include internal diagnostics to verify that the instrument passes the internal circuit tests, and calibration routines to check and adjust the instrument internal calibration constants.

Diagnostics

This procedure uses internal routines to verify that the instrument is operating correctly. No test equipment or hookups are required.

The instrument automatically performs the internal diagnostics when powered on; you can also run the internal diagnostics using the menu selections described in this procedure. The difference between these two methods of initiating the diagnostics is that the menu method does a more detailed memory check than the power–on method.

Equipment required	None
Prerequisites	Power on the instrument and allow a twenty–minute warmup period before doing this procedure.

Confirm that there is no output being performed by verifying that the RUN LED is not on. If the LED is on, push the **RUN** button to turn it off.

Do the following to verify that the instrument passes the internal circuit tests:

Push **UTILITY** (front–panel)→**Diag** (bottom)→**Diagnostic All** (side).

The diagnostic menu is displayed and all tests are selected. Refer to Figure B-35. If All is not displayed, select All using the general purpose knob.

The list on the screen shows the test items and results in the calibration and diagnostics previously made. Select all of the test items shown on the screen or use the general purpose knob to select a single test item that you want to run.

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The result of the diagnostics are shown as error code. Pass means that the tests have been made without error. If an error is detected, an error code is displayed.

You can also specify how many times the diagnostic tests are performed. Push the **Cycle** side button and then turn the general purpose knob to select the cycle from 1, 3, 10, 100 or Infinite. When you select Infinite, the tests are repeatedly performed, and are not be terminated until you push the **Abort Diagnostic** side button.

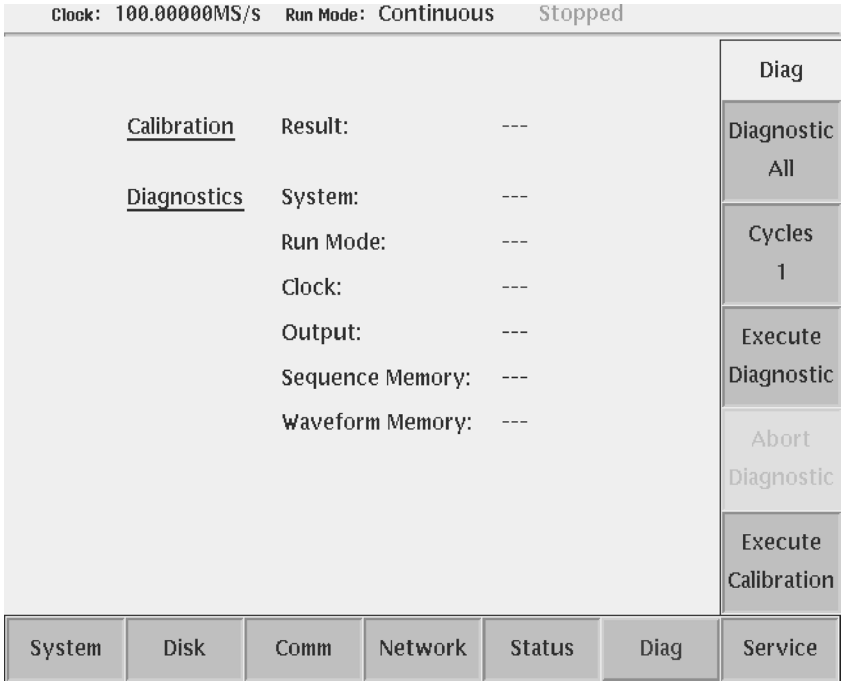


Figure B-35: Diagnostic menu

Do the following to execute all of the AWG710 Arbitrary Waveform Generator diagnostics automatically:

Push the **Execute Diagnostic** side button.

The internal diagnostics do an extensive verification of AWG710 Arbitrary Waveform Generator functions. While this verification progresses, the screen displays the clock icon. When finished, the resulting status appears on the screen.

Verify that no failures are found and reported on–screen. If the diagnostics terminates without error, Pass is displayed instead of the – – –. If a value is displayed, meaning an error is detected, consult a qualified service technician for further assistance.

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Push any bottom or menu button (other than UTILITY) to exit the diagnostic screen.

Calibration

The instrument includes internal calibration routines that check electrical characteristics such as offset, attenuations and filters. Perform calibration to adjust internal calibration constants as necessary. This procedure describes how to do the internal calibration.

Equipment required	None
Prerequisites	Power on the instrument and allow a 20 minute warmup period at an ambient temperature between +20° C and +30° C before doing this procedure.

Confirm that there is no output being performed by verifying that the RUN LED is not on. If the LED is on, push the **RUN** button to turn it off.

NOTE. *Some calibration items may fail if you start calibration while output is being performed.*

Do the following steps to verify that the internal adjustments have passed:

1. Push **UTILITY** (front–panel)→**Diag** (bottom)→ **Execute Calibration** (side).

   This executes the AWG710 Arbitrary Waveform Generator calibration routines automatically.

The internal calibration does an extensive verification of proper AWG710 Arbitrary Waveform Generator functions. While this verification progresses, the message box displaying *Executing Calibration* appear on screen. When finished, the resulting status will appear in the message box as shown in Figure B-36.

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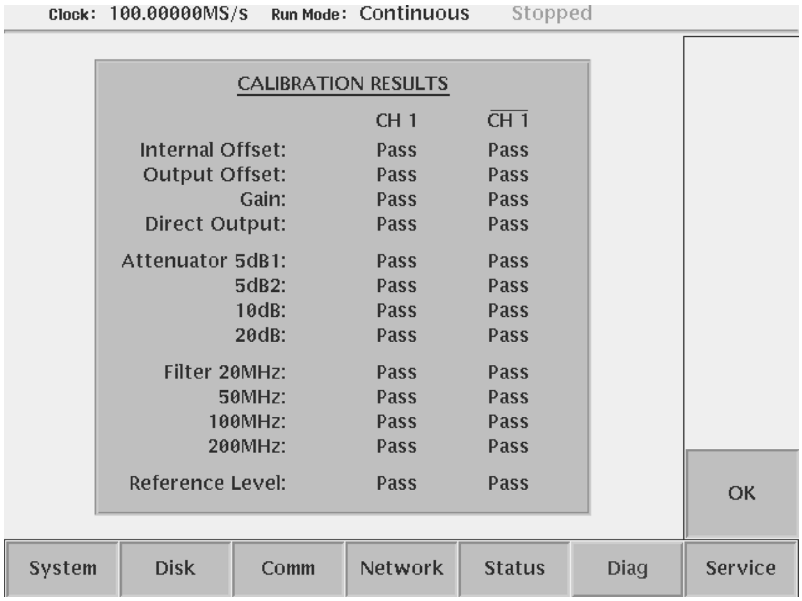


Figure B-36: Calibration result message box (except option 02)

Verify that no failures are found and reported in the message box. If the calibration displays Fail as the result, consult a qualified service technician for further assistance.

2. Push the **OK** side button and then any bottom or menu button (other than the **UTILITY**) to exit the dialog screen.

NOTE. *The calibration data in the memory may be lost if the instrument is powered off while the calibration is executed,*

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Performance Tests

This section contains a collection of procedures for checking that the AWG710 Arbitrary Waveform Generator performs as warranted.

The procedures are arranged in eight logical groupings, presented in the following order:

Table B-4: Performance test items

Titles	See (performance verification)	Test items	See (specifications)
Operating mode tests	Page B-66	Continuous, Triggered, and Gated mode normality	Page A-28
Amplitude and offset accuracy tests (normal out)	Page B-72	Amplitude accuracy, and DC offset accuracy	Page A-29
Amplitude, DC offset and rise time accuracy tests (direct DA out)	Page B-77	Amplitude accuracy, DC offset accuracy and Rise time accuracy	Page A-30
Amplitude, DC offset and Rise time accuracy test (Option2)	Page B-81	Amplitude accuracy, DC offset accuracy and Rise time accuracy	Page A-30
Pulse response tests (normal out)	Page B-85	Rise time accuracy	Page A-30
Trigger input tests	Page B-87	Trigger level accuracy, and Trigger function normality	Page A-33
Event input and enhanced mode tests	Page B-91	External event input function normality, and Event mode normality	Page A-35
1/4 Clock frequency and 10 MHz reference input tests	Page B-98	1/4 clock output frequency and Reference input normality accuracy	Page A-31
Marker output tests	Page B-100	Marker output level accuracy	Page A-31

The performance tests check all of the characteristics that are designated as checked in *Appendix A:Specifications.* (The characteristic items that must be checked are listed with the check mark (✓) in *Appendix A: Specifications*).

NOTE. *These procedures extend the confidence level provided by the basic procedures described on page B-56. The basic procedures should be done first, and then these procedures performed if desired.*

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Prerequisites

The tests in this section comprise an extensive, valid confirmation of performance and functionality when the following requirements are met:

- The cabinet must be installed on the instrument.
- You must have performed and passed the procedures under *Self Tests,* found on page B-56.
- The waveform generator must have been recently adjusted at an ambient temperature between +20° C and +30° C, must have been operating for a warm–up period of at least 20 minutes, and must be operating at an ambient temperature between +10° C and +40° C.

Refer to *Conventions* on page B-55 for more information.

Equipment Required

These procedures use external, traceable signal sources to directly check warranted characteristics. Table B-5 lists the required equipment used to complete the performance tests.

Table B-5: Test equipment

Item number and description		Minimum requirements	Example (recommended)	Purpose
1.	Frequency Counter	1 MHz to 100 MHz, Accuracy: < 0.2 ppm	Anritsu MF1603A	Checks reference input.
2.	Digital multi meter	DC volts range: 0.05 V to 10 V, Accuracy: ±0.1 %	Fluke 8842A	Measures voltage. Used in multiple procedures.
3.	Oscilloscope	Bandwidth: > 500 MHz, 1 MΩ and 50 Ω inputs	Tektronix TDS784D	Checks output signals. Used in multiple procedures.
4.	Oscilloscope	Bandwidth: > 6 GHz, Rise time: < 58.3 ps, 50 Ω input	Tektronix TDS820	Checks pulse response.
5.	Function Generator	Output voltage: -5 V to +5 V, Frequency accuracy: < 0.01 %	Tektronix AFG310	Generates external input signals. Used in multiple input signal test procedures.
6.	SMA Coaxial Cable (2 required)	50 Ω, male to male SMA connectors	Tektronix part number 174–1427–00	Signal interconnection
7.	BNC Coaxial Cable (3 required)	50 Ω, male to male BNC connectors	Tektronix part number 012–0482–00	Signal interconnection
8.	Adapter (2 required)	SMA (male) to BNC (female), 50 Ω	Tektronix part number 015–0554–00	Signal interconnection
9.	Adapter	SMA (female) to BNC (male), 50 Ω	Tektronix part number 015–0572–00	Signal interconnection
10.	BNC–T Connector	BNC (male) to BNC (female) to BNC (female)	Tektronix part number 103–0030–00	Signal interconnection
11.	Dual–Banana Connector	BNC (female) to dual banana	Tektronix part number 103–0090–00	Signal interconnection

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Table B-5: Test equipment (cont.)

Item number and description		Minimum requirements	Example (recommended)	Purpose
12.	SMA Terminator (2 required)	50 Ω, SMA (male)	Tektronix part number 015–1022–01	Signal termination
13.	Precision Terminator	50 Ω, 0.1 %, BNC	Tektronix part number 011–0129–00	Signal termination
14.	Performance check disks	Must use example listed	Supplied with the product, Tektronix part number 062–A273–00	Used to provide waveform files.
15.	Ground closure (loopback cable) with 9–pin, D–type connector		Custom, See Figure B-37.	Used for event mode test.

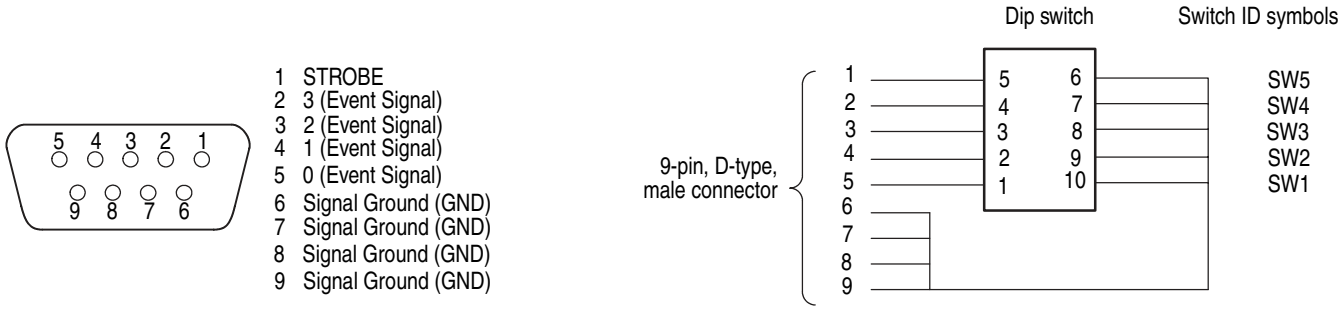


Figure B-37: EVENT IN connector pins and signals and ground closure connector

Loading Files

The following steps explain how to load files from the Performance Check/Adjustment disk into waveform memory and/or sequence memory.

1. Insert the disk into the AWG710 Arbitrary Waveform Generator floppy disk drive.
2. Select **SETUP** (front)→**Waveform/Sequence** (bottom)→**Load...** (side)→**Drive...** (side).

   The Select Drive dialog box appears as show in Figure B-38.

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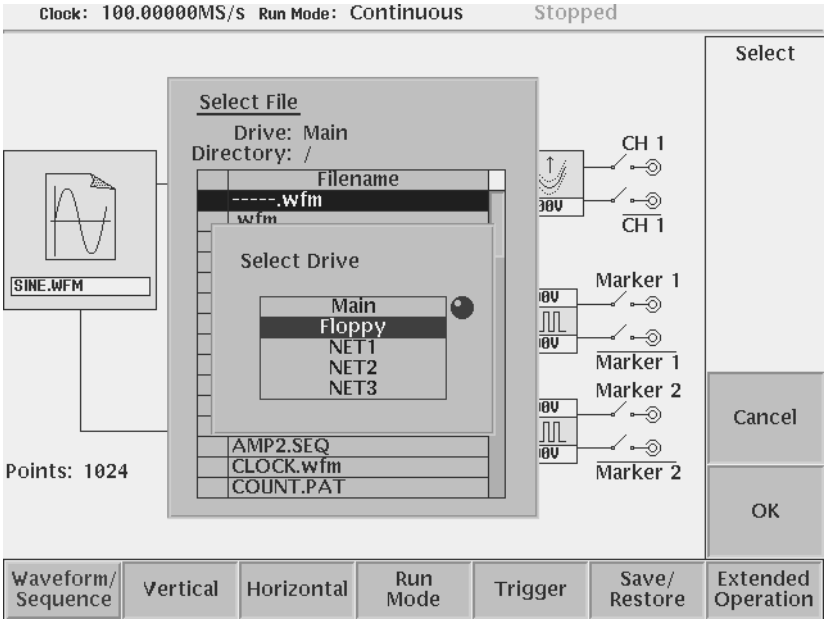


Figure B-38: Loading file; selecting storage drive

3. Select **Floppy** from the dialog box with the general purpose knob, and then push the **OK** side button.

   The Select Drive dialog box disappears, and the files in the floppy disk are listed on the Select File dialog box.

4. Use the general purpose knob to select a file to be loaded from the dialog box, and then push the **OK** side button.

   The waveform or sequence you selected is loaded into the instrument, and the instrument is also setup with the parameters stored in that file.

5. Remove the floppy disk from the floppy drive if the floppy disk is no longer needed.

6. Push any bottom button or menu button to exit the menu.

NOTE. *The floppy disk file list displayed on the screen does not automatically update when you replace the diskette with another diskette. To update the file list, reselect the floppy disk drive.*

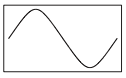
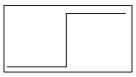
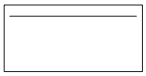
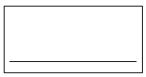
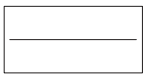
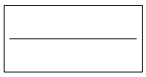
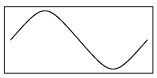
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Performance Check/Adjustment Files

Table B-6 lists the sequence and waveform files on the Performance Check/Adjustment disk that are used in these performance tests, the AWG710 Arbitrary Waveform Generator front–panel settings that each file sets up, and the performance test that uses each file.

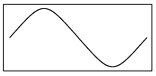
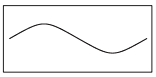
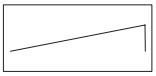
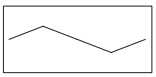
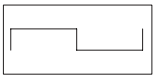
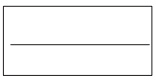
NOTE. *The files on the Performance Check disk are locked (the files are marked by the icon in the file list), so the data in these files cannot be changed unless the lock is opened.*

Table B-6: Waveforms and sequences in performance check disk

No.	File name	EDIT menu		SETUP menu				Marker setup	Usage
		Form	Points	Clock	Filter	Ampl	Offset		
1	MODE.WFM		1000	4 GHz	Through	1 V	0 V	Marker 1,2: 0 to 499: High, 500 to 999: Low	Run mode,Trigger level, Internal trigger accuracy
2	PULSE.WFM		1000	100 MHz	Through	1 V	0 V		Pulse response
3	AMP1.SEQ								Amplitude accuracy (Normal out), Marker
4	AMP2.SEQ								Amplitude accuracy (Direct out)
5	DC_P.WFM (AMPx.SEQ) [1]		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
6	DC_M.WFM (AMPx.SEQ) [1]		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
7	DC0.WFM (AMP2.SEQ)		1000	100 MHz	Through	1 V	0 V		Amplitude accuracy
8	OFFSET.WFM		1000	100 MHz	Through	20 mV	0 V		Offset accuracy
9	TRIG.WFM		1000	1 MHz	Through	1 V	0 V		Trigger input
10	PT_EVENT.SEQ								Event input
11	PT_STROB.SEQ								Event input

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Table B-6: Waveforms and sequences in performance check disk (cont.)

No.	File name	EDIT menu		SETUP menu				Marker setup	Usage
		Form	Points	Clock	Filter	Ampl	Offset		
12	S1024.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
13	S1024H.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
14	R1024H.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
15	T1024H.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
16	Q1024H.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input
17	NULL1024H.WFM (PT_xxxxx.SEQ) [2]		1024	400 MHz	Through	1 V	0 V		Event input

[1] **The AMPx.SEQ represents AMP1.SEQ and AMP2.SEQ.**

[2] **The PT_xxxxx.SEQ represents PT_EVENT.SEQ and PT_STROB.SEQ**

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Operating Mode Tests

The following procedures verify the operation of the Cont, Triggered and Gated modes.

NOTE. *When you output signal from the CH1 or $\overline{CH1}$ OUTPUT, check that the other OUTPUT ($\overline{CH1}$ or CH1) LED is off.*
If the other OUTPUT LED is on, push the $\overline{CH1}$ or CH1 OUT button to turn off the output.

Check Cont Mode

Equipment required	A 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter and an oscilloscope (TDS700).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure B-39).

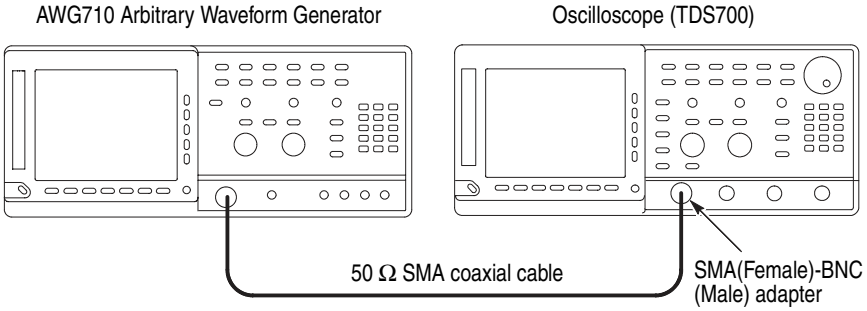


Figure B-39: Cont mode initial test hookup

2. Set the oscilloscope controls as follows:

Vertical CH1
CH1 coupling. . . . . DC
CH1 scale . . . . . 200 mV/div
CH1 input impedance . . . . . 50 Ω
Horizontal
Sweep . . . . . 100 ns/div

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Trigger

Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

Do the following steps to set the AWG710 Arbitrary Waveform Generator controls and to select the waveform file:

1. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).
2. Load the MODE.WFM file.

   Refer to *Loading Files* on page B-62 for file loading procedures.
3. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connectors are on.
4. Check that the amplitude of the sine wave displayed on the oscilloscope is 5 vertical divisions and that a waveform of approximately one cycle per 2.5 horizontal divisions is displayed.

Check Triggered Mode

The following table lists the equipment and prerequisites required to check the Triggered mode.

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter, a BNC–T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS700).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable and a BNC–T adapter to connect the function generator output connector to the AWG710 Arbitrary Waveform Generator TRIG IN connector. Refer to Figure B-40.
2. Connect a second 50 Ω BNC coaxial cable to the BNC–T adapter. Connect the opposite end of the coaxial cable to the oscilloscope CH2 input.
3. Use a 50 Ω SMA coaxial cable and SMA(Fe)–BNC(Ma) adapter to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector.

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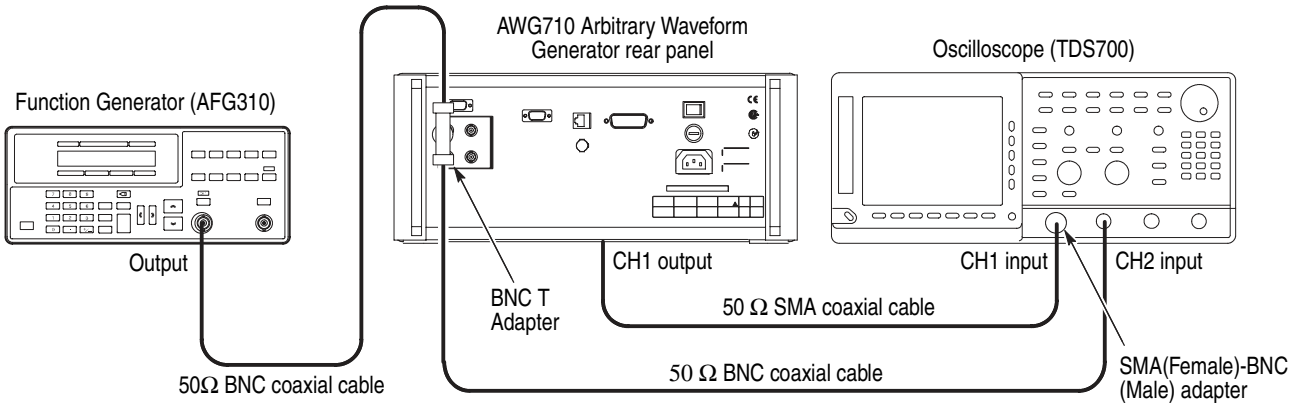


Figure B-40: Triggered mode initial test hookup

4. Set the oscilloscope controls as follows:

VerticalCH1 and CH2	
CH1 and CH2 coupling	DC
CH1 scale	500 mV/div
CH2 scale	2 V/div
CH1 input impedance	50 Ω
CH2 input impedance	1 MΩ
Horizontal	
Sweep	200 ns/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	NORMAL

5. Set the function generator (AFG310) controls as follows:

Function	Square
‘Mode	Continuous
Parameters	
Frequency	1 MHz
Amplitude	2.0 V into 50 Ω (4.0 V into 1 MΩ)
Offset	1.0 V into 50 Ω (2.0 V into 1 MΩ)
Output	Off

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6. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the waveform file:

   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

   b. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Triggered** (side)

   c. Load the MODE.WFM file.

   Refer to *Loading Files* on page B-62 for file loading procedures.

   d. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connectors are on.

   e. Push the **FORCE TRIGGER** button.

   Verify that the oscilloscope displays a one–cycle sine wave when the FORCE TRIGGER button is pushed. You may need to adjust the horizontal position control to see the signal.

7. Follow the substeps below to check the triggered mode with external triggering:

   a. Turn on the function generator output.

   b. Verify that the oscilloscope displays a one–cycle sine wave for each trigger supplied by the function generator. See Figure B-41.

   Retain the test hookup.

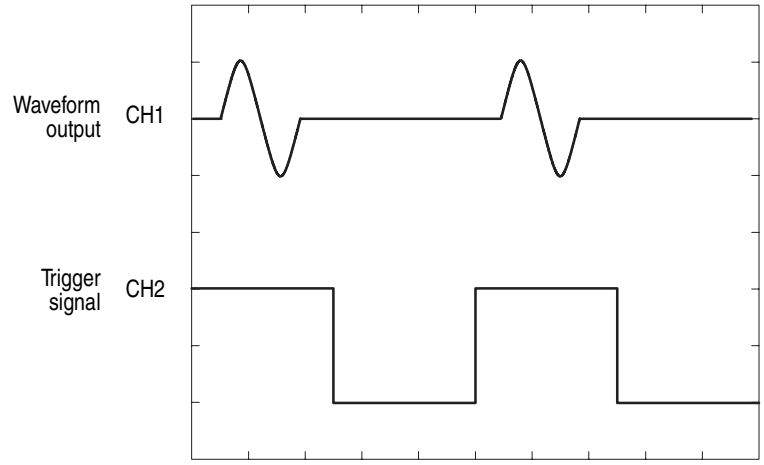


Figure B-41: Relationship between trigger signal and waveform output

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Check Gated Mode

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter, a BNC–T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS700).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

1. Set the oscilloscope controls as follows:

- Vertical . . . . . CH1 and CH2
  - CH1 and CH2 coupling . . . . . DC
  - CH1 scale . . . . . 500 mV/div
  - CH2 scale . . . . . 2 V/div
  - CH1 input impedance . . . . . 50 Ω
  - CH2 input impedance . . . . . 1 MΩ
- Horizontal
  - Sweep . . . . . 20 µs/div
- Trigger
  - Source CH1
  - Coupling . . . . . DC
  - Slope . . . . . Positive
  - Level . . . . . 100 mV
  - Mode . . . . . NORMAL

2. Set the function generator (AFG310) controls as follows:

- Function . . . . . Square
- Mode . . . . . Continuous
- Parameters
  - Frequency . . . . . 10.1 kHz
  - Amplitude . . . . . 2.0 V into 50 Ω (4.0 V into 1 MΩ)
  - Offset . . . . . 1.0 V into 50 Ω (2.0 V into 1 MΩ)
- Output . . . . . Off

3. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the waveform file:

a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

b. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Gated** (side).

c. Load the MODE.WFM file.

Refer to *Loading Files* on page B-62 for file loading procedures.

d. Push **HORIZONTAL MENU** (front–panel)→ **Clock** (side).

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e. Push **1**, **0**, **0** and **M** (SHIFT+7) keys in this order or turn the general purpose knob to set the internal clock frequency to 100 MHz.

f. Push the **RUN** and **CH1** output buttons.

The LEDs above the **RUN** button and **CH1** output connector are on.

g. Push the **FORCE TRIGGER** button.

Verify that the oscilloscope displays sine waves while the FORCE TRIGGER button is pushed and that the output stops when the Force Trigger button is released.

4. Follow the substeps below to check the gated mode with the gate signal:

a. Set the oscilloscope trigger source to CH2 and change the trigger level to 1 V.

b. Turn on the function generator output.

c. Verify that the oscilloscope displays sine waves while the function generator gate signal amplitude is High level. See Figure B-42.

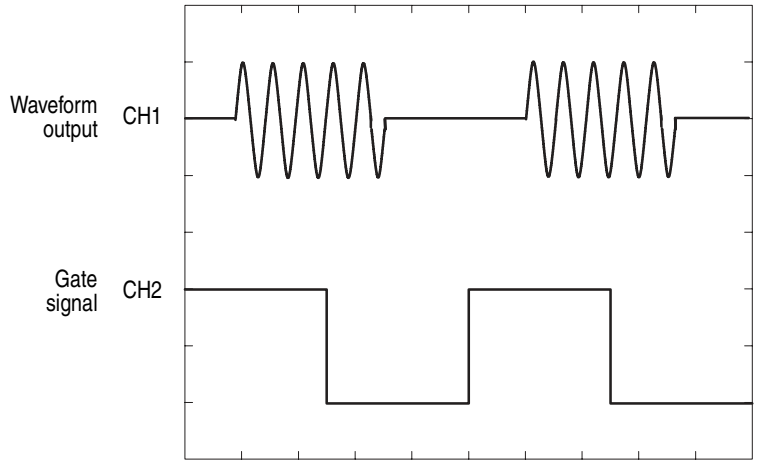


Figure B-42: Relationship between gate signal and waveform output

d. Push **SETUP** (front–panel)→**Trigger** (bottom)→**Negative** (side).

This changes the AWG710 Arbitrary Waveform Generator trigger polarity to negative.

5. Verify that the oscilloscope displays sine waves while the function generator gate signal amplitude is Low level.

6. Turn off the function generator output and disconnect from the oscilloscope.

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Amplitude and Offset Accuracy Tests (Normal Out), (except option 02)

These procedures check the accuracy of the amplitude and offset outputs of the AWG710 Arbitrary Waveform Generator.

NOTE. *The amplitude and offset accuracy checks are structured as a continuous test. The next test uses the control settings from the previous test and uses the next step in the sequence file.*

NOTE. *When you output signal from the $\overline{CH1}$ or CH1 OUTPUT, check that the other OUTPUT ($\overline{CH1}$ or CH1) LED is off.*
If the other OUTPUT LED is on, push the $\overline{CH1}$ or CH1 OUT button to turn off the output.

Check Amplitude Accuracy

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, a SMA(Ma)–BNC(Fe) adapters, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, a SMA(Ma)–BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC–to–dual banana adapter to connect the AWG710 Arbitrary Waveform Generator CH1 output to the DMM input connector (see Figure B-43).

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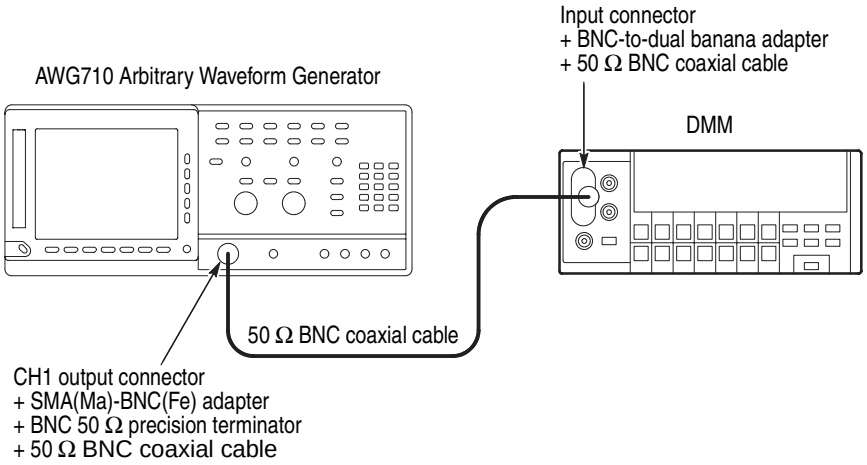


Figure B-43: Amplitude accuracy initial test hookup

2. Set the DMM controls as follows:

Mode	VDC
Range	Auto
Input	Front

3. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the sequence file:

   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

   b. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side).

   The AWG710 Arbitrary Waveform Generator is set to enhanced mode.

   c. Load the AMP1.SEQ file.

   Refer to *Loading Files* on page B-62 for file loading procedures.

4. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connector are on.

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5. Do the following substeps to set the AWG710 Arbitrary Waveform Generator amplitude and confirm the offset setting:

   a. Push **VERTICAL MENU** (front–panel)→**Amplitude** (side).

   b. Push **0, ., 0, 2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.020 V.

   c. Verify that the offset setting display on the Offset side button is 0.000 V.

   If the offset display is not set correctly, push the **Offset** side button, and push **0** and then **ENTER** key.

6. Do the following substeps to check the amplitude accuracy of a 20 mV amplitude setting:

   a. Write the DMM reading as a positive voltage.

   b. Push the **FORCE EVENT** button.

   c. Write the DMM reading as a negative voltage.

   d. Verify that the positive minus negative voltages fall within 20 mV ± 2.4 mV.

   e. Push **0, ., 2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.200 V.

7. Do the following to check the amplitude accuracy of 200 mV amplitude setting:

   a. Push the **FORCE EVENT** button.

   b. Write the DMM reading as a positive voltage.

   c. Push the **FORCE EVENT** button.

   d. Write the DMM reading as a negative voltage.

   e. Verify that the positive minus negative voltages fall within 200 mV ± 6 mV.

   f. Push the **2** and the **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 2 V.

8. Do the following substeps to check the amplitude accuracy of 2 V amplitude setting:

   a. Push the **FORCE EVENT** button.

   b. Write the DMM reading as a positive voltage.

   c. Push the **FORCE EVENT** button.

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d. Write the DMM reading as a negative voltage.

e. Check that the positive minus negative voltages fall within 2 V ± 0.042 V.

9. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

a. Push the **CH1** output button.

b. Disconnect the adapter, terminator and cable from the **CH1** output connector.

c. Connect the adapter, terminator, and the cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.

d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

10. Repeat the *Check Amplitude Accuracy* procedure for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$ beginning on page B-72.

11. Reconnect the test hookup on the $\overline{\text{CH1}}$ output to the CH1 output. Retain the control settings.

Check Offset Accuracy

The following procedure checks the Offset Accuracy.

1. Use the test hookup and settings from previous check on page B-72 and B-73.

2. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the sequence file:

a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

b. Load the OFFSET.WFM file.

Refer to *Loading Files* on page B-62 for file loading procedures.

c. Push **VERTICAL MENU** (front–panel)→**Amplitude** (side).

d. Push **0, ., 0, 2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.020 V.

3. Push the **RUN** and **CH1** output buttons.

The LEDs above the RUN button and CH1 output connector are on.

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4. Do the following substeps to set the *AWG710 Arbitrary Waveform Generator* offset:
   a. Push the **Offset** side button.
   b. Push **0** and **ENTER** keys in this order.
   c. Verify that the reading on the DMM falls within 0 V ± 10 mV.
   d. Push **0**, **.** , **5** and **ENTER** keys in this order to change the AWG710 Arbitrary Waveform Generator offset to 0.5 V.
   e. Verify that the reading on the DMM falls within 0.5 V ± 0.0175 V.
   f. Push **–**, **0**, **.** , **5** and **ENTER** keys in this order to change the AWG710 Arbitrary Waveform Generator offset to –0.5 V.
   g. Check that the reading on the DMM falls within –0.5 V ± 0.0175 V.
5. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:
   a. Push the **CH1** output button.
   b. Disconnect the adapter, terminator and cable from the **CH1** output connector.
   c. Connect the adapter, terminator, and cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.
   d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.
6. Repeat the *Check Offset Accuracy* procedure for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$.
7. Push the **$\overline{\text{CH1}}$** output button to turn off the **$\overline{\text{CH1}}$** LED.
8. Disconnect the test hookup from the $\overline{\text{CH1}}$ output connector.

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Amplitude, Offset Accuracy and Rise Time Tests (Direct DA Out), (except option 02)

These procedures check the accuracy of the AWG710 Arbitrary Waveform Generator direct waveform outputs; amplitude and offset.

Check Amplitude and DC Offset

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, an SMA(Ma)–BNC(Fe) adapter, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, an SMA(Ma)–BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC–to–dual banana adapter to connect the AWG710 Arbitrary Waveform Generator **CH1** output to the DMM input connector (see Figure B-44).

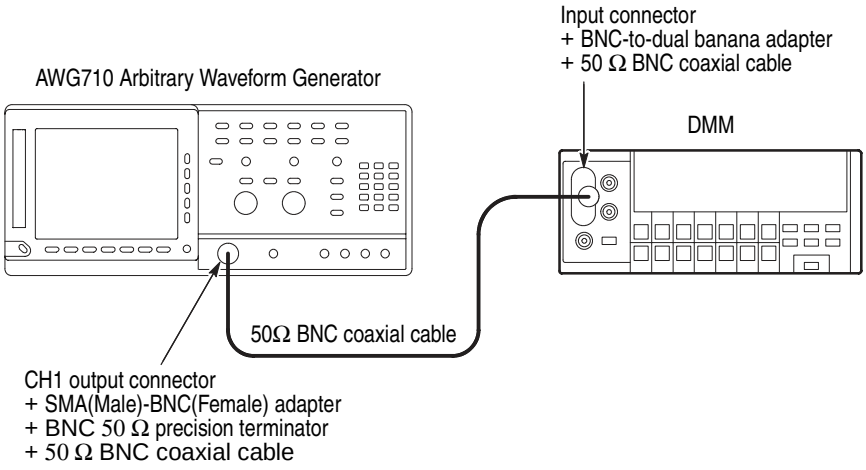


Figure B-44: Direct DA output amplitude accuracy initial test hookup

2. Set the DMM controls as follows:

   Mode . . . . . VDC
   Range . . . . . 2 V
   Input . . . . . Front

3. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

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4. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side).

   The AWG710 Arbitrary Waveform Generator is set to enhanced mode.

5. Push **VERTICAL MENU** (front–panel)→**Output** (side)→**Direct** (side).

6. Load the AMP2.SEQ file.

   Refer to *Loading Files* on page B-62 for file loading procedures.

7. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connector are on.

8. Do the following substeps to check the direct DA amplitude accuracy of 1 V amplitude setting:

   a. Write the DMM reading as a positive voltage.

   b. Push the **FORCE EVENT** button.

   c. Write the DMM reading as a negative voltage.

   d. Verify that the positive minus negative voltages fall within 1.0 V ± 0.022 V.

   e. Push **VERTICAL MENU** (front–panel)→**Amplitude** (side).

   f. Push **0, .,0, 2** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.020 V.

9. Do the following to check the direct DA amplitude accuracy of 20 mV amplitude setting:

   a. Push the **FORCE EVENT** button twice.

   b. Write the DMM reading as a positive voltage.

   c. Push the **FORCE EVENT** button.

   d. Write the DMM reading as a negative voltage.

   e. Verify that the positive minus negative voltages fall within 20 mV ± 2.4 mV.

10. Follow the substeps below to check the DC offset:

    a. Push the **FORCE EVENT** button.

    b. Verify that the reading on the DMM falls within 0 V ±10 mV.

11. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

    a. Push the **CH1** output button.

    b. Disconnect the adapter, terminator and cable from the **CH1** output connector.

    c. Connect the adapter, terminator, and cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.

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d. Push the **CH1** output button to turn on the CH1 LED.

e. Push the **FORCE EVENT** button.

12. Repeat steps 8 through step 10 for the AWG710 Arbitrary Waveform Generator CH1.

13. Push the **CH1** output button to turn off the CH1 LED.

14. Push the **RUN** button to turn off the RUN LED.

15. Disconnect the DMM.

Check Pulse Rise Time

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use the 50 Ω SMA coaxial cable to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure B-45).

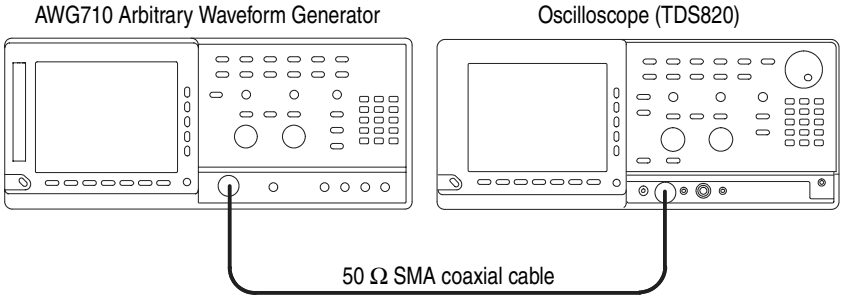


Figure B-45: Direct DA output pulse rise time initial test hookup

2. Set the oscilloscope controls as follows:

Vertical CH1
CH1 coupling. . . . . DC if applicable
CH1 scale . . . . . 100 mV/div
Horizontal

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Sweep	500 ps/div
Trigger	
Source	CH1
Slope	⎍
Level	0 V
Mode	Auto

NOTE. *The pulse rise time tests use the AWG710 Arbitrary Waveform Generators control settings that have been used in the amplitude and DC offset tests. Do not initialize the AWG710 Arbitrary Waveform Generator controls.*

3. Load the PULSE.WFM file.

   Refer to *Loading Files* on page B-62 for file loading procedures.

4. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Continuous** (side).

   The AWG710 Arbitrary Waveform Generator is set to the Continuous mode.

5. Change the AWG710 Arbitrary Waveform Generator controls as follows:

   a. Push **VERTICAL MENU** (bottom)→**Amplitude** (side).

   b. Push **0, ., 5** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.5 V.

   c. Verify that the Direct DA out is set. If not, push **Output** (side)→**Direct** (side).

6. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connectors are on.

7. Verify that the rise time of the pulse waveform displayed on the oscilloscope is equal to or less than 280 ps.

8. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

   a. Push the **CH1** output button.

   b. Disconnect the cable from the CH1 output connector.

   c. Connect the cable to the $\overline{\text{CH1}}$ output connector.

   d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

9. Repeat step 7 to verify the rise time for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$.

10. Push the **$\overline{\text{CH1}}$** output button to turn off the $\overline{\text{CH1}}$ LED.

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Amplitude, Offset Accuracy and Rise Time Tests (for option 02)

These procedures check the accuracy of the AWG710 Arbitrary Waveform Generator option02 outputs; amplitude and offset.

Check Amplitude and DC Offset

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, an SMA(Ma)–BNC(Fe) adapter, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710 option 02 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, an SMA(Ma)–BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC–to–dual banana adapter to connect the AWG710 Arbitrary Waveform Generator **CH1** output to the DMM input connector (see Figure B-46).

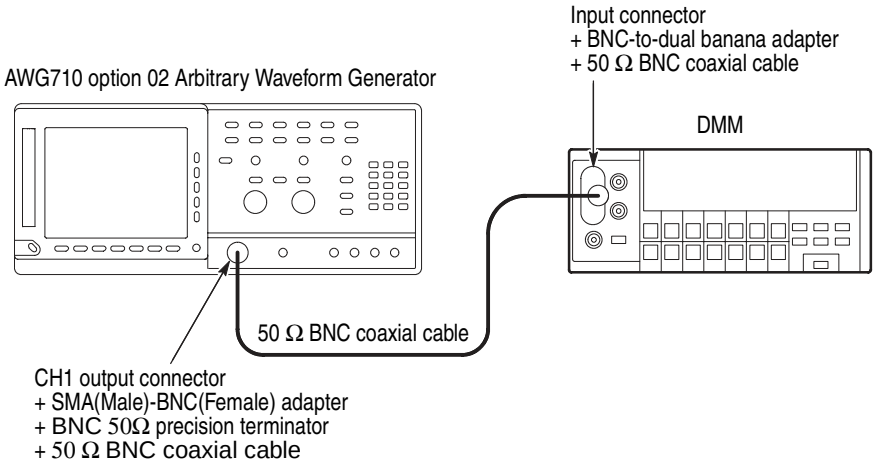


Figure B-46: Option02 output amplitude accuracy initial test hookup

2. Set the DMM controls as follows:

   Mode . . . . . VDC
   Range . . . . . 2 V
   Input . . . . . Front

3. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

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4. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side).

   The AWG710 Arbitrary Waveform Generator is set to enhanced mode.

5. Load the AMP2.SEQ file.

   Refer to *Loading Files* on page B-62 for file loading procedures.

6. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connector are on.

7. Do the following substeps to check the option02 amplitude accuracy of 1 V amplitude setting:

   a. Write the DMM reading as a positive voltage.

   b. Push the **FORCE EVENT** button.

   c. Write the DMM reading as a negative voltage.

   d. Verify that the positive minus negative voltages fall within 1.0 V ± 0.022 V.

   e. Push **VERTICAL MENU** (front–panel)→**Amplitude** (side).

   f. Push **0, . , 5** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 0.500 V.

8. Do the following to check the option02 amplitude accuracy of 500 mV amplitude setting:

   a. Push the **FORCE EVENT** button twice.

   b. Write the DMM reading as a positive voltage.

   c. Push the **FORCE EVENT** button.

   d. Write the DMM reading as a negative voltage.

   e. Verify that the positive minus negative voltages fall within 500 mV ± 12 mV.

9. Follow the substeps below to check the DC offset:

   a. Push the **FORCE EVENT** button.

   b. Verify that the reading on the DMM falls within 0 V ±10 mV.

10. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

    a. Push the **CH1** output button.

    b. Disconnect the adapter, terminator and cable from the **CH1** output connector.

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c. Connect the adapter, terminator, and cable (removed in step b) to the $\overline{\text{CH1}}$ output connector.

d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

e. Push the **FORCE EVENT** button.

11. Repeat steps 7 through step 9 for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$.

12. Push the **$\overline{\text{CH1}}$** output button to turn off the $\overline{\text{CH1}}$ LED.

13. Push the **RUN** button to turn off the RUN LED.

14. Disconnect the DMM.

Check Pulse Rise Time

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use the 50 Ω SMA coaxial cable to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure B-47).

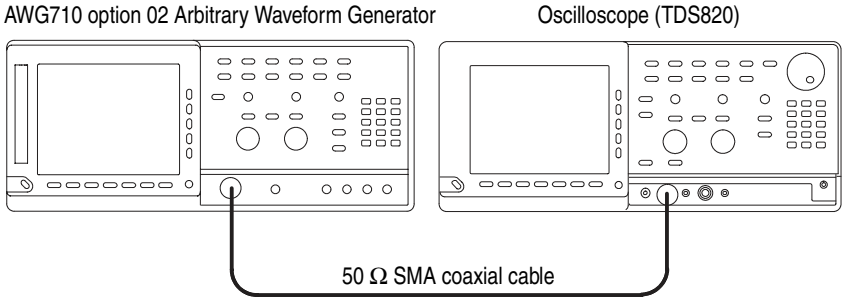


Figure B-47: Optipn02 output pulse rise time initial test hookup

2. Set the oscilloscope controls as follows:

Vertical CH1
CH1 coupling. . . . . DC if applicable
CH1 scale . . . . . 200 mV/div
Horizontal
Sweep . . . . . 200 ps/div

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Trigger

Source	CH1
Slope	⎍
Level	0 V
Mode	Auto

NOTE. *The pulse rise time tests use the AWG710 Arbitrary Waveform Generators control settings that have been used in the amplitude and DC offset tests. Do not initialize the AWG710 Arbitrary Waveform Generator controls.*

3. Load the PULSE.WFM file.

   Refer to *Loading Files* on page B-62 for file loading procedures.

4. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Continuous** (side).

   The AWG710 Arbitrary Waveform Generator is set to the Continuous mode.

5. Change the AWG710 Arbitrary Waveform Generator controls as follows:

   a. Push **VERTICAL MENU** (bottom)→**Amplitude** (side).

   b. Push **1** and **ENTER** keys in this order or turn the general purpose knob to set the amplitude to 1 V.

6. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connectors are on.

7. Verify that the rise time of the pulse waveform displayed on the oscilloscope is equal to or less than 175 ps.

8. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

   a. Push the **CH1** output button.

   b. Disconnect the cable from the CH1 output connector.

   c. Connect the cable to the $\overline{\text{CH1}}$ output connector.

   d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

9. Repeat step 7 to verify the rise time for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$.

10. Push the **$\overline{\text{CH1}}$** output button to turn off the $\overline{\text{CH1}}$ LED.

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Pulse Response Tests (Normal Out), (except option 02)

This procedure checks the pulse response characteristics of the AWG710 Arbitrary Waveform Generator output waveforms at amplitudes of 1 V.

Equipment required	A 50 Ω SMA coaxial cable and an oscilloscope (TDS820).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use the 50 Ω SMA coaxial cable to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector (see Figure B-48).

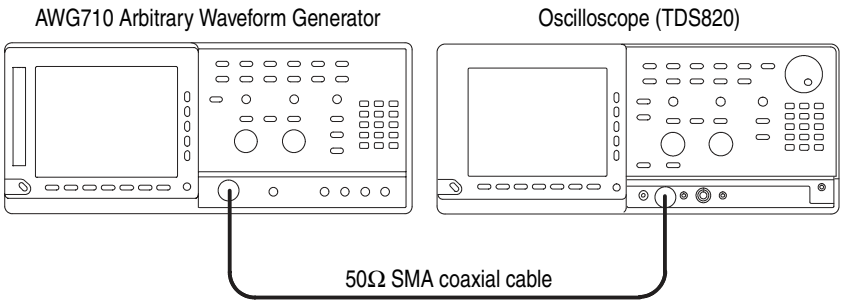


Figure B-48: Pulse response initial test hookup

2. Set the oscilloscope controls as follows:

Vertical CH1
- CH1 coupling . . . . . DC if applicable
- CH1 scale . . . . . 200 mV/div

Horizontal
- Sweep . . . . . 500 ps/div

Trigger
- Source CH1
- Slope . . . . . Positive
- Level . . . . . 0 V
- Mode . . . . . Auto

3. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side) →**OK** (side).

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4. Load the PULSE.WFM file.

   Refer to *Loading Files* on page B-62 for file loading procedures.

5. Push the **RUN** and **CH1** output buttons.

   The LEDs above the RUN button and CH1 output connector are on.

6. Verify the pulse response at 1 V amplitude.

   a. Verify that the rise time of the waveform displayed on the oscilloscope from 10% to 90% point is equal to or less than 480 ps.

7. Do the following substeps to change the connection to check the $\overline{\text{CH1}}$:

   a. Push the **CH1** output button.

   b. Disconnect the cable from the CH1 output connector.

   c. Connect the cable to the $\overline{\text{CH1}}$ output connector.

   d. Push the **$\overline{\text{CH1}}$** output button to turn on the $\overline{\text{CH1}}$ LED.

8. Repeat the *Check Pulse Response procedure* for the AWG710 Arbitrary Waveform Generator $\overline{\text{CH1}}$.

9. Push the **$\overline{\text{CH1}}$** output button to turn off the **$\overline{\text{CH1}}$ LED.**

10. Disconnect the oscilloscope.

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Trigger Input Tests

These procedures check the trigger level accuracy of the AWG710 Arbitrary Waveform Generator.

Equipment required	Two 50 Ω BNC coaxial cables, a 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter, a BNC–T (male to 2 females) adapter, a function generator, and an oscilloscope (TDS700).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable and an SMA(Fe)–BNC(Fe) adapter to connect the AWG710 Arbitrary Waveform Generator CH1 output connector to the oscilloscope CH1 input connector.
2. Use a BNC coaxial cable to connect the function generator to the BNC–T adapter which goes to the Trigger Input on the AWG710. Connect a 50 Ω BNC coaxial cable to the BNC–T adapter. Connect the opposite end of the BNC cable to the CH2 input on the oscilloscope.

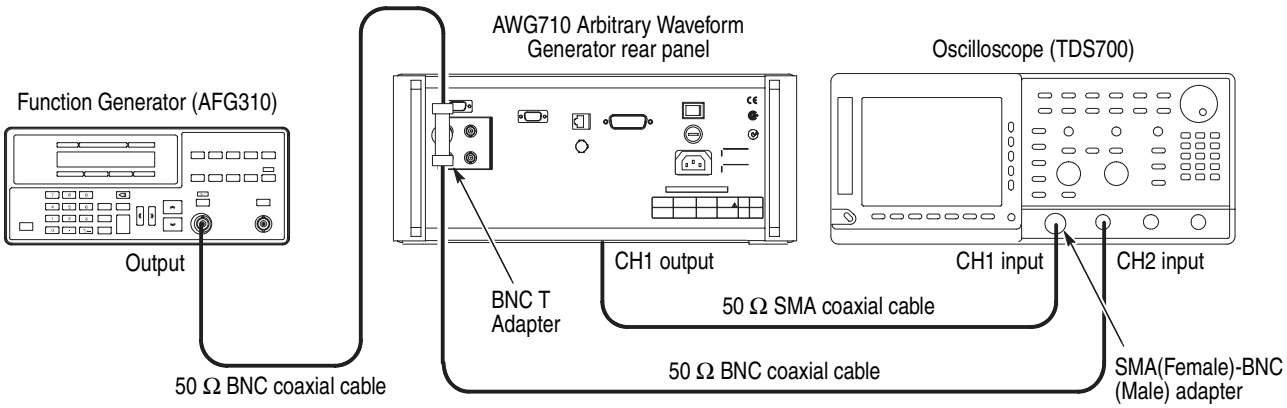


Figure B-49: Trigger input initial test hookup

3. Set the oscilloscope controls as follows:

Vertical	CH1 and CH2
CH1 and CH2 coupling	DC
CH1 scale	500 mV/div
CH2 scale	2 V/div

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CH1 input impedance	50 Ω
CH2 input impedance	1 M Ω
Horizontal	
Sweep	1 ms/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

a. Set the function generator controls as follows:

Function	DC
Mode	Continuous
Output	Off

b. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

c. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Gated** (side).

d. Load the TRIG.WFM file**.**

Refer to *Loading Files* on page B-62 for file loading procedures.

4. Push the **RUN** and **CH1 OUT** buttons.

The LEDs above the RUN button and CH1 output connector are on.

5. Set the trigger level to 5 V by the following substeps below:

a. Push **SETUP** (front–panel)→**Trigger** (bottom)→**Level** (side).

b. Push **5** and **ENTER** keys in this order.

6. Set the trigger input signal level to 4.65 V by the following substeps below:

a. Turn on the function generator output.

b. Select offset by pressing the **OFFSET** button of function generator.

c. Set the DC waveform high level to 4.65 V by using cursor keys.

d. Check that no waveform is displayed on the oscilloscope as shown in Figure B-50.

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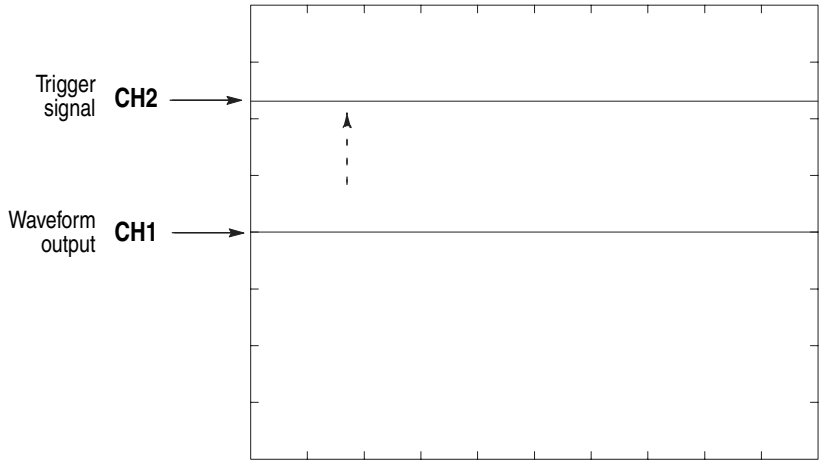


Figure B-50: Trigger signal and waveform output (+5 V check 1)

e. Change the pulse waveform high level to 5.35 V by using cursor keys.

f. Check that sine waves are displayed on the oscilloscope as shown in Figure B-41.

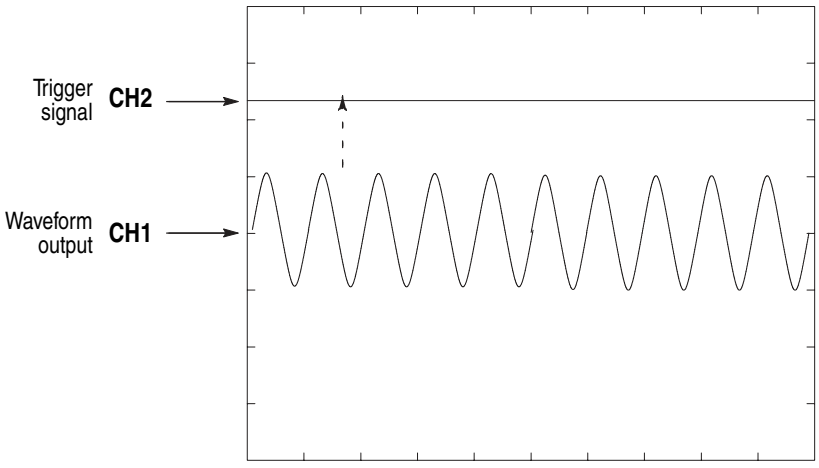


Figure B-51: Trigger signal and waveform output (+5 V check 2)

7. Follow the substeps below to check trigger level accuracy at –5 V:

a. Push **–, 5** and **ENTER** keys in this order.

b. Set the DC waveform low level of function generator to –5.35 V by using cursor keys.

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c. Check that no waveform is being displayed on the oscilloscope as shown in Figure B-52.

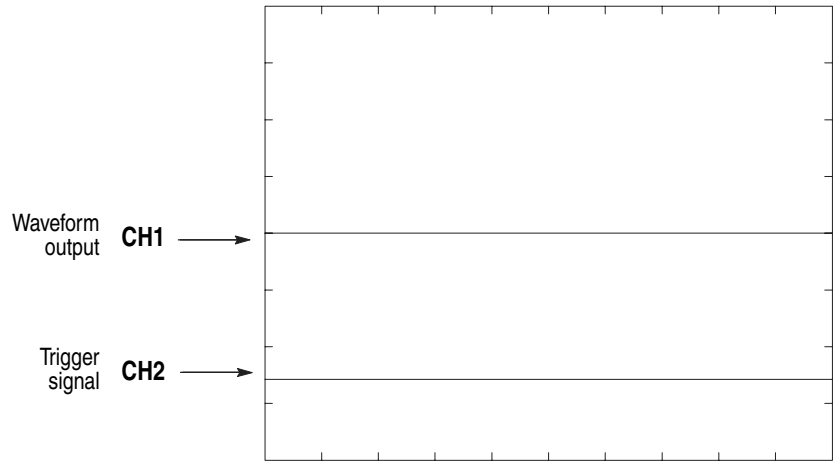


Figure B-52: Trigger signal and waveform output (-5 V check 1)

d. Change the pulse waveform low level of function generator to –4.65 V by using cursor keys.

e. Check that sine waves are displayed on the oscilloscope as shown in Figure B-53.

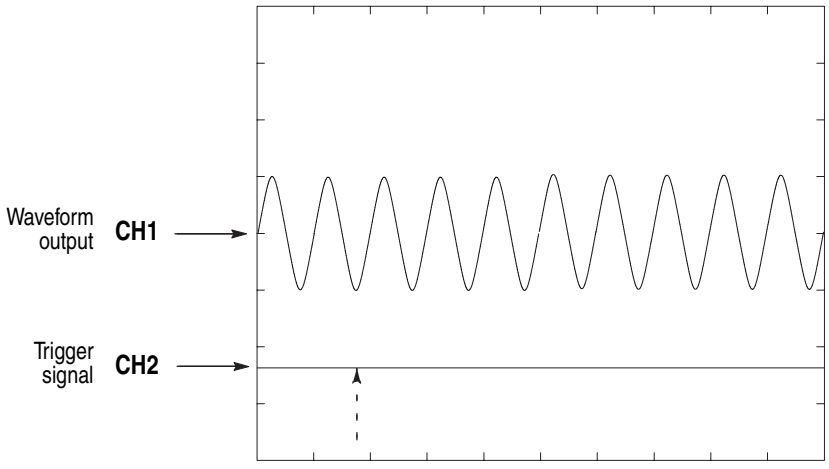


Figure B-53: Trigger signal and waveform output (-5 V check 2)

8. Push the **RUN** button and the CH1 button to turn off the RUN LED.

9. Turn off the function generator output, disconnect the function generator.

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Event Input and Enhanced Mode Tests

These procedures check the event input signals and enhanced mode operation.

NOTE. *The event input check with strobe off and the strobe input check are structured as a continuous test. After* Check Event Input with Strobe Off*, the next test uses the connections and oscilloscope settings from the previous test.*

Check Event Input with Strobe Off

Equipment required	A 50 Ω SMA coaxial cable, a SMA(Fe)–BNC(Ma) adapter an oscilloscope (TDS700), and custom–made ground closure. See Figure B-37 for the connections.
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50Ω SMA coaxial cable and a SMA(Fe)–BNC(Fe) adapter to connect the AWG710 Arbitrary Waveform Generator **CH1** output connector to the oscilloscope CH1 input connector (see Figure B-54).

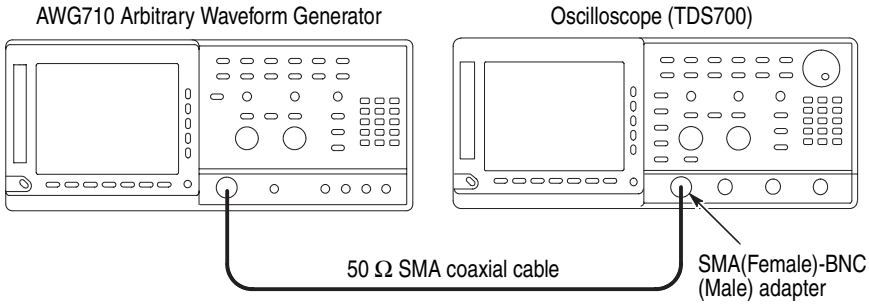


Figure B-54: Event input and enhanced mode initial test hookup

2. Connect the ground closure to the EVENT IN connector on the AWG710 Arbitrary Waveform Generator rear panel.

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3. Set the oscilloscope controls as follows:

Vertical	CH1
CH1 coupling	DC
CH1 scale	200 mV/div
CH1 input impedance	50 Ω
Horizontal	
Sweep	500 ns/div or 400 ns/div
Trigger	
Source	CH1
Coupling	DC
Slope	Positive
Level	+100 mV
Mode	Auto

4. Set all the switches of the ground closure to open.

5. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and select the sequence file:

   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

   b. Load the PT_EVENT.SEQ file**.**

   Refer to *Loading Files* on page B-62 for file loading procedures.

   c. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the enhanced mode.

6. Push the **RUN** and **CH1 OUT** buttons.

   The LEDs above the RUN button and CH1 output connector are on.

7. Check the EVENT IN connector pin 0 input:

   a. Verify that a waveform displayed on the oscilloscope has the same amplitude as shown in Figure B-55.

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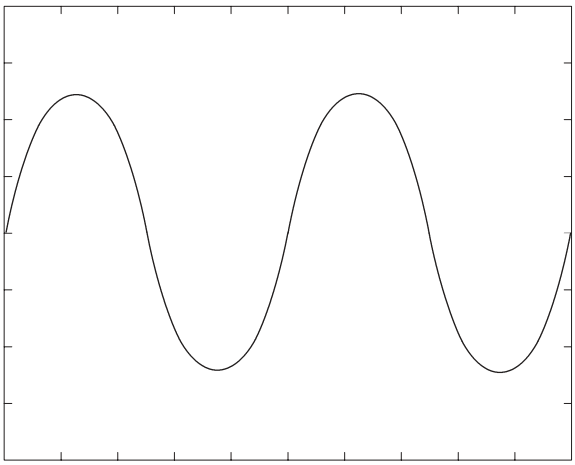


Figure B-55: Waveform while all ground disclosure switches are open

b. Close the SW1 of the ground closure to generate an event signal on the EVENT IN connector pin 0.

c. Verify that the oscilloscope displays the waveform as shown in Figure B-56 and that the waveform amplitude is the half size of Figure B-55.

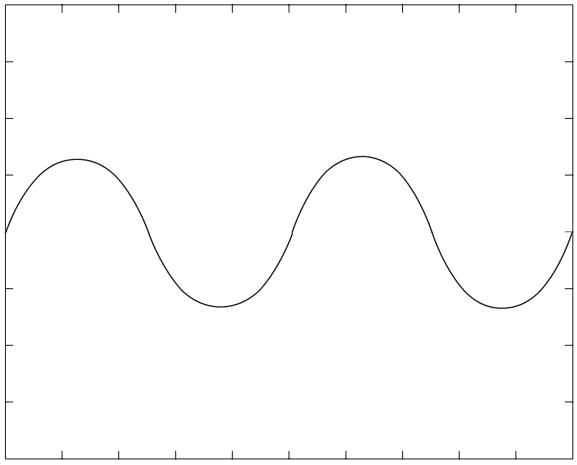


Figure B-56: Waveform output when the SW1 is closed

d. Open SW1 of the ground closure to degenerate the event signal.

e. Verify that the oscilloscope displays the waveform in Figure B-55.

8. Check the EVENT IN connector pin 1 input:

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a. Close SW2 of the ground closure to generate an event signal on the EVENT IN connector pin 1.

b. Verify that the oscilloscope displays the waveform as shown in Figure B-57.

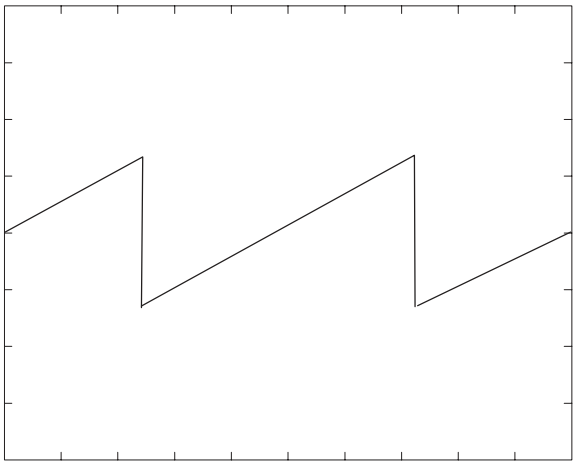


Figure B-57: Waveform output when SW2 is closed

c. Open the SW2 of the ground closure to degenerate the event signal.

d. Verify that the oscilloscope displays the waveform shown in Figure B-55.

9. Check the EVENT IN connector pin 2 input:

a. Close SW3 of the ground closure to generate an event signal on the EVENT IN connector pin 2.

b. Verify that the oscilloscope displays the waveform shown in Figure B-58.

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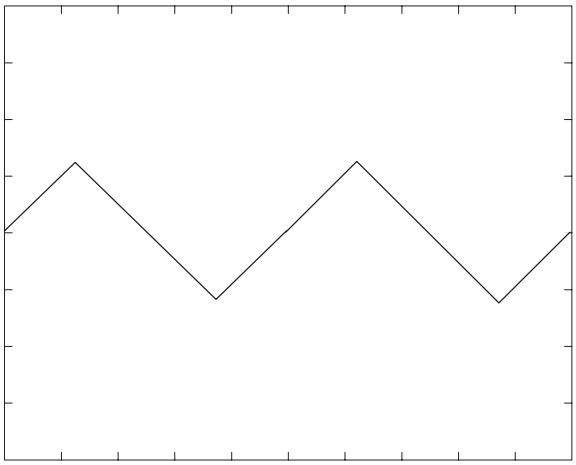


Figure B-58: Waveform output when the SW3 is closed

c. Open SW3 of the ground closure to degenerate the event signal.

d. Verify that the oscilloscope displays the waveform in Figure B-55.

10. Check the EVENT IN connector pin 3 input:

a. Close the SW4 of the ground closure to generate an event signal on the EVENT IN connector pin 3.

b. Verify that the oscilloscope displays the waveform shown in Figure B-59.

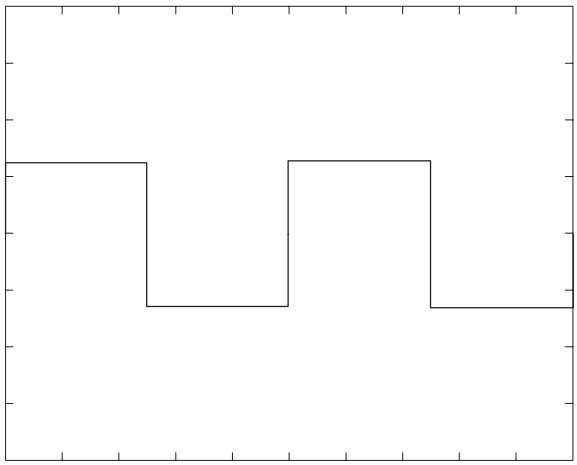


Figure B-59: Waveform output when SW4 is closed

c. Open SW4 of the ground closure to degenerate the event signal.

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d. Verify that the oscilloscope displays the waveform in Figure B-55.

11. Retain the test hookup and control settings.

Check Strobe Input

Use the test hookup and oscilloscope settings from previous check.

1. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and select the sequence file:

a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

b. Load the PT_STROB.SEQ file**.**

Refer to *Loading Files* on page B-62 for file loading procedures.

c. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side) to set the run mode to enhanced.

2. Push the **RUN** and **CH1 OUT** buttons.

The LEDs above the RUN button and CH1 output connector are on.

3. Check the EVENT IN connector strobe pin input:

a. Verify that the waveform displayed on the oscilloscope has the same amplitude as shown in Figure B-60.

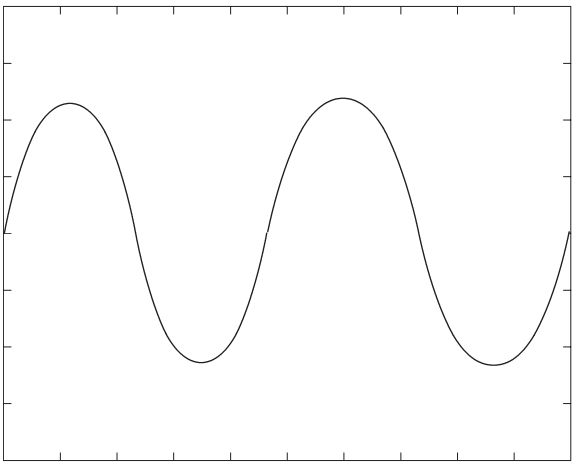


Figure B-60: Initial waveform output

b. Close SW5 of the ground closure to generate an event signal on the EVENT IN connector strobe pin.

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c. Verify that the oscilloscope displays the DC waveform as shown in Figure B-61.

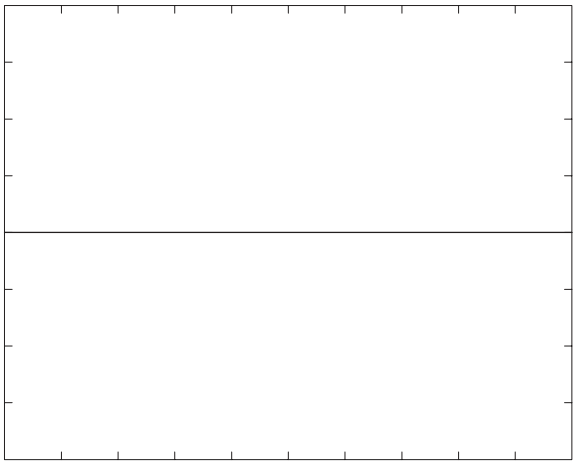


Figure B-61: DC waveform output when the SW5 is closed

d. Open SW5 of the ground closure to degenerate the strobe signal on the EVENT IN connector strobe pin.

e. Verify that the DC waveform is displayed on the oscilloscope.

f. Close SW5 of the ground closure again.

g. Verify that the oscilloscope displays the waveform as shown in Figure B-60.

4. Push the **CH1 OUT** button to turn off the CH1 LED.

5. Disconnect the oscilloscope and ground closure.

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1/4 Clock Frequency and 10 MHz Reference Input Tests

These procedures check the 10 MHz reference input function of the AWG710 Arbitrary Waveform Generator.

Equipment required	A 50 Ω SMA coaxial cable, A 50 Ω BNC coaxial cable, a SMA(Fe)–BNC(Ma) adapter, a frequency counter, and a function generator.
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω SMA coaxial cable and SMA(Fe)–BNC(Ma) adapter to connect the AWG710 Arbitrary Waveform Generator 1/4 CLOCK OUT connector to the input A connector on the frequency counter.
2. Use a 50 Ω BNC coaxial cable to connect the AWG710 Arbitrary Waveform Generator 10 MHz REF IN connector to the function generator output connector (see Figure B-62).

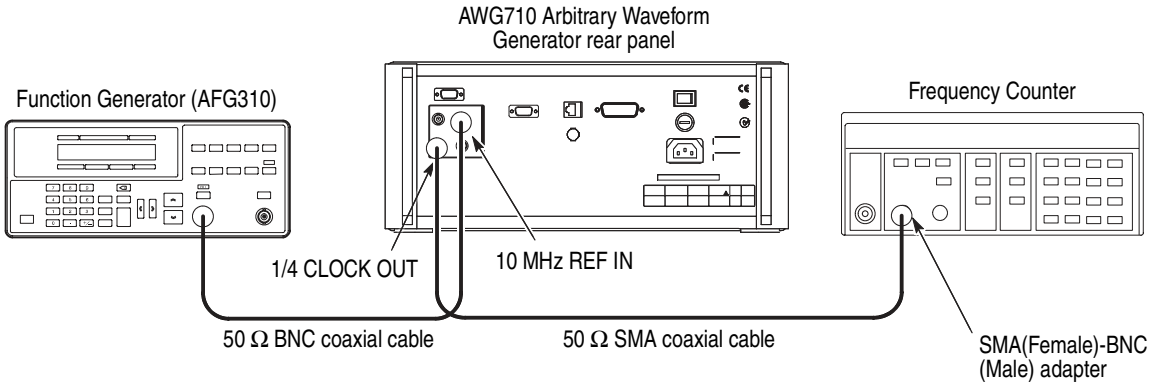


Figure B-62: 1/4 Clock frequency and 10 MHz reference input initial test hookup

a. Set the frequency counter controls as follows:

INPUT A
Coupling . . . . . AC
FUNCTION . . . . . A FREQ
Gate time . . . . . 0.2 s
Trigger Level . . . . . 0 V

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b. Set the function generator (AFG310) controls:

Function	Square
Mode	Continuous
Parameters	
Frequency	10 MHz
Amplitude	2.0 V into 50 Ω (4.0 V into 1 MΩ)
Offset	0 V
Output	On

Check 1/4 Clock frequency

1. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and select the waveform file:

   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

   b. Load the MODE.WFM file.

   Refer to *Loading Files* on page B-62 for file loading procedures.

   c. Push **HORIZONTAL MENU** (front–panel)→**Clock** (side).

   d. Push **2, 0**, **0** and **M** (SHIFT+7) keys in this order or turn the general purpose knob to set the internal clock frequency to 200 MHz.

2. Push the **RUN** button.

   The LED above the RUN button is on.

3. Verify that the frequency counter reading is 50 MHz ± 50 Hz (using internal reference clock).

4. Retain the test hookup.

Check 10MHz Reference Input

5. Push **HORIZONTAL MENU** (front–panel)→**Clock Ref** (side) so that the AWG710 Arbitrary Waveform Generator reference clock is set to External.

6. Verify that the frequency counter reading is 50.0 MHz ±10 kHz (using external reference clock).

7. Change the function generator controls as follows:

Frequency	10.1 MHz

8. Check that the frequency counter reading is 50.5 MHz ±10 kHz.

9. Turn the function generator output off and disconnect the function generator and frequency counter.

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Marker Output Tests

These procedures check the accuracy of the AWG710 Arbitrary Waveform Generator marker output level.

NOTE. *Connect a 50Ω SMA terminator to the inverted marker output connector during the marker output tests.*

Equipment required	A 50 Ω BNC coaxial cable, a 50 Ω precision terminator, a SMA(Ma)–BNC(Fe) adapters, BNC (female)–to–dual banana adapter, and a digital multimeter (DMM).
Prerequisites	The AWG710 Arbitrary Waveform Generator must meet the prerequisites listed on page B-61.

Do the following steps to install the test hookup and set the test equipment controls:

1. Use a 50 Ω BNC coaxial cable, a SMA(Ma)–BNC(Fe) adapter, a 50 Ω precision terminator, and a BNC–to–dual banana adapter to connect the AWG710 Arbitrary Waveform Generator MARKER 1 OUT to the DMM input connector (see Figure B-63).

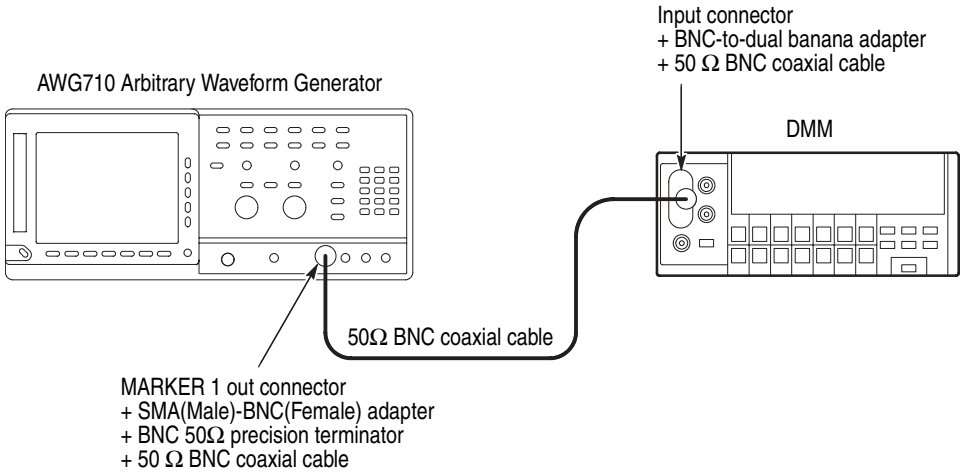


Figure B-63: Marker output initial test hookup

2. Set the DMM controls as follows:

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Mode	VDC
Range	Auto
Input	Front

3. Follow the substeps below to set the AWG710 Arbitrary Waveform Generator controls and to select the sequence file:

   a. Push **UTILITY** (front–panel)→**System** (bottom)→**Factory Reset** (side)→**OK** (side).

   b. Push **SETUP** (front–panel)→**Run Mode** (bottom)→**Enhanced** (side).

   The AWG710 Arbitrary Waveform Generator is set to enhanced mode.

   c. Load the AMP1.SEQ file.

   Refer to *Loading Files* on page B-62 for file loading procedures.

4. Push the **RUN** button.

   The LEDs above the RUN button is on.

5. Do the following substeps to set the AWG710 Arbitrary Waveform Generator marker output high level setting:

   a. Push **VERTICAL MENU** (front–panel)→**Marker...** (side)→**Marker 1 High Level** (side).

   b. Push **3, ., 0** and **ENTER** keys in this order or turn the general purpose knob to set the marker level to 3.0 V.

   c. Verify that the marker 1 high level reading on the DMM screen falls within 2.75 V through 3.25 V.

   d. Push the **FORCE EVENT** button.

6. Do the following substeps to set the AWG710 Arbitrary Waveform Generator marker output low level setting:

   a. Push **Marker 1 Low Level** side button.

   b. Push **-, 1, ., 1** and **ENTER** keys in this order or turn the general purpose knob to set the marker level to -1.1 V.

   c. Verify that the marker 1 low level reading on the DMM screen falls within -1.255 V through -0.945 V.

   d. Push the **FORCE EVENT** button.

7. Do the following substeps to change the connection to check the $\overline{\text{MARKER1}}$:

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a. Disconnect the 50 Ω precision terminator from the $\overline{\text{MARKER1}}$ OUT connector.

b. Disconnect the cable (with SMA(Ma)-BNC(Fe) adapter and BNC 50 Ω terminator) from MARKER 1 OUT connector.

c. Connect the 50 Ω precision terminator to the MARKER 1 OUT (removed in step a).

d. Connect the adapter, terminator, and the cable (removed in step b) to the $\overline{\text{MARKER1}}$ OUT connector.

8. Press Force Event where needed.

9. Repeat steps 5 and 6 for the AWG710 Arbitrary Waveform Generator $\overline{\text{MARKER1}}$ OUT.

10. Repeat steps 5 through 8 for MARKER 2 OUT and $\overline{\text{MARKER2}}$ OUT.

11. Disconnect the DMM.

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Appendix C: Inspection and Cleaning

Inspect and clean the instrument as often as operating conditions require. The collection of dirt can cause instrument overheating and breakdown. Dirt acts as an insulating blanket, preventing efficient heat dissipation. Dirt also provides an electrical conduction path that can cause an instrument failure, especially under high–humidity conditions.



CAUTION. *To prevent damage avoid the use of chemical cleaning agents that might damage the plastics used in this instrument. Use only deionized water when cleaning the menu buttons or front–panel buttons. Use a ethyl alcohol solution as a cleaner and rinse with deionized water.*

Avoid the use of high pressure compressed air when cleaning dust from the interior of this instrument. (High pressure air can cause ESD.) Instead, use low pressure compressed air (about 9 psi).

Inspection — Exterior

Using Table C-1 as a guide, inspect the outside of the instrument for damage, wear, and missing parts. You should thoroughly check instruments that appear to have been dropped or otherwise abused to verify correct operation and performance. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

Table C-1: External inspection check list

Item	Inspect for	Repair action
Cabinet, front panel, and cover	Cracks, scratches, deformations, damaged hardware or gaskets	Replace defective module
Front–panel knobs	Missing, damaged, or loose knobs	Repair or replace missing or defective knobs
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors	Replace defective modules; clear or wash out dirt
Carrying handle and cabinet feet	Correct operation	Replace defective module
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors	Replace damaged or missing items, frayed cables, and defective modules

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Cleaning Procedure — Exterior



WARNING. *To avoid injury or death, unplug the power cord from line voltage before cleaning the instrument. To avoid getting moisture inside the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.*

1. Remove loose dust on the outside of the instrument with a lint–free cloth.
2. Remove remaining dirt with a lint free cloth dampened in a general purpose detergent–and–water solution. Do not use abrasive cleaners.
3. Clean the monitor screen with a lint–free cloth dampened with either ethyl alcohol or, preferably, a gentle, general purpose detergent–and–water solution.

Cleaning the Instrument Interior

Only qualified personnel should access the inside of the AWG710&AWG710B for inspection and cleaning, refer to the *Maintenance* section in the AWG710&AWG710B service manual.

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Appendix D: Sample Waveforms

The files listed below are included in the route directory of the sample waveform library disk that comes with the instrument.

There are 22 waveform and equation files. If a waveform file (with the extension **.WFM**) has the same name as an equation file (with the extension .**EQU**), the waveform file was derived by compiling that equation file.

Table D-1: Waveform and equation files in the sample disk

No	Waveform name	File name	
1	Gaussian Pulse	GAUSS_P.EQU	GAUSS_P.WFM
2	Lorentz Pulse	LORENTZ.EQU	LORENTZ.WFM
3	Sampling Function SIN(X)/X Pulse	SINC.EQU	SINC.WFM
4	Squared Sine Pulse	SQU_SIN.EQU	SQU_SIN.WFM
5	Double Exponential Pulse	D_EXP.EQU	D_EXP.WFM
6	Nyquist Pulse	NYQUIST.EQU	NYQUIST.WFM
7	Linear Frequency Sweep	LIN_SWP.EQU	LIN_SWP.WFM
8	Log Frequency Sweep	LOG_SWP.EQU	LOG_SWP.WFM
9	Amplitude Modulation	AM.EQU	AM.WFM
10	Frequency Modulation	FM.EQU	FM.WFM
11	Pulse Width Modulation		PWM.WFM
12	Pseudo–random Pulse		PRBS9.WFM
13	Waveform for Magnetic Disk Signal		DSK.WFM
14	Isolated pulse for Disk application	PR4.EQU	
15	Isolated pulse for Disk application	EPR4.EQU	
16	Isolated pulse for Disk application	E2PR4.EQU	
17	Isolated pulse for Network application		E1.WFM
18	Isolated pulse for Network application		DS1.WFM
19	Isolated pulse for Network application		DS1A.WFM
20	Isolated pulse for Network application		DS2.WFM
21	Isolated pulse for Network application		DS3.WFM
22	Isolated pulse for Network application		STS-1.WFM

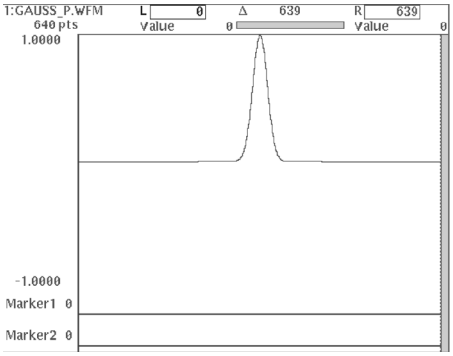
These sample waveform and equation files can be copied, distributed, or modified according to your purposes.

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Waveform File Descriptions

This subsection describes the 22 representative waveform files. Some of the waveform files were obtained by creating an equation file in the equation editor and then compiling it to create a waveform file. Others were created in the waveform editor or disk application. To output a waveform file, select the file in the SETUP menu.

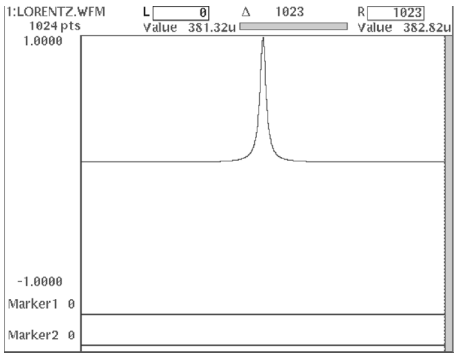
Table D-2: Gaussian pulse



File name	GAUSS_P.WFM	Made with equation editor
Equation	size = 1000 clock = 1e9 'pulse width k0 = 30e '9'peak location k1 = 500e-9 "gauss_p.wfm" = exp(-log(2) * ((2* (time - k1) / k0) ^ 2))	
Descriptions	The waveform that is generated when the pulse width is tW50 and the peak location is 0 can be expressed as: $V(t) = exp\left\{-In(2)\cdot\left(\frac{2t}{t_{w50}}\right)^2\right\}$ Substituting $\sigma = \frac{t_{w50}}{2\sqrt{2In(2)}}$ gives, $f(t) = exp\left(-\frac{t^2}{2\sigma^2}\right)$ and taking the Fourier transform gives: $F(j\omega) = \sqrt{2\pi}\sigma\cdot exp\left(-\frac{\omega^2\sigma^2}{2}\right)$ This shows that this signal has a form in the frequency domain as well.	
Example	When t_{w50} is 30 ns, the bandwidth will be 10.4 MHz.	
Settings	Waveform points: 640, Clock frequency: 1.0 GHz, Output time: 640 ns	

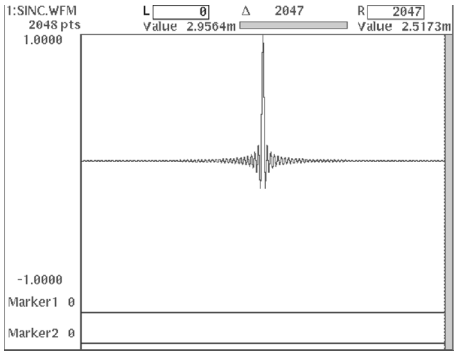
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Table D-3: Lorentz pulse



File name	LORENTZ_P.WFM	Made with equation editor
Equation	size = 1024 clock = 1e9 'pulse width k0 = 20e-9 'peak location k1 = 512e-9 "lorentz.wfm" = 1 / (1+(2*(time - k1) / k0) ^ 2)	
Descriptions	When the pulse width is taken to be tw50, the waveform can be expressed by the following formula: $V(t) = \frac{1}{1+\left(2\frac{t}{t_{w50}}\right)^2}$	
Settings	Waveform points: 1024, Clock frequency: 1.0 GHz, Output time: 1024 ns	

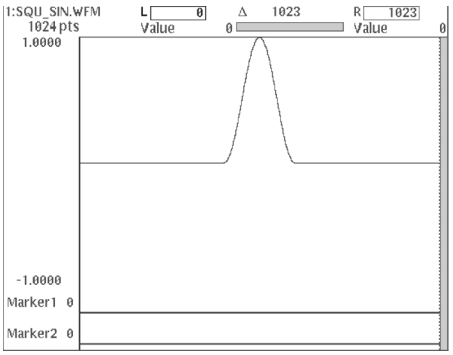
Table D-4: Sampling function SIN(X)/X pulse



File name	SINC.WFM	Made with equation editor
Equation	size = 2048 clock = 1e9 'sine frequency k0 = 50e6 'peak location k1 = 1024e-9 "sinc.wfm" = sinc(2 * pi * k0 * (time - k1))	
Descriptions	In general, this waveform is expressed by the following formula: $V(t) = \frac{sin(2\pi ft)}{2\pi ft}$ This is the impulse response for the ideal low pass filter for the frequency bandwidth f. At least 42 periods are required to use a vertical resolution of 8 bits.	
Settings	Waveform points: 2048, Clock frequency: 1.0 GHz, Output time: 2048 ns	

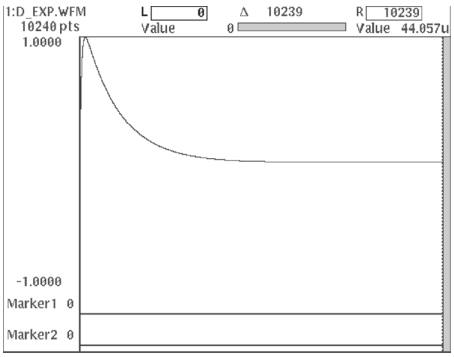
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Table D-5: Squared sine pulse



File name	SQU_SIN.WFM	Made with equation editor
Equation	clock = 1e9 size = 412 “tmp1” = 0 size = 200 “tmp2” = (cos (2 * pi * (scale - 0.5)) + 1) / 2 “tmp3” = join (“tmp1”, “tmp2”) “squ_sin.wfm” = join (“tmp3”, “tmp1”) delete (“tmp1”) delete (“tmp2”) delete (“tmp3”)	
Descriptions		
Settings	Waveform points: 1024, Clock frequency: 1.0 GHz, Output time: 412 ns	

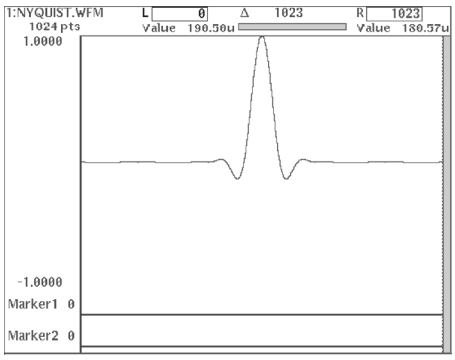
Table D-6: Double exponential pulse



File name	D_EXP.WFM	Made with equation editor
Equation	clock = 1e9 size = 10240 k1 = 50e-9 ’rise time constant k2 = 1000e-9 ’fall time constant “tmp” = exp (-time / k2) - exp (-time /k1) “d_exp.efm” = norm (“tmp”) delete (“tmp”)	
Descriptions	This is the waveform when a charged capacitor is discharged to the RC circuit. When the time constants for charging and discharging are taken to be τ_1 and τ_2, respectively, the waveform can be expressed by the following formula: $V(t) = exp\left(-\frac{t}{\tau_2}\right) - exp\left(-\frac{t}{\tau_1}\right)$	
Settings	Waveform points: 10240, Clock frequency: 1.0 GHz, Output time: 10240 ns	

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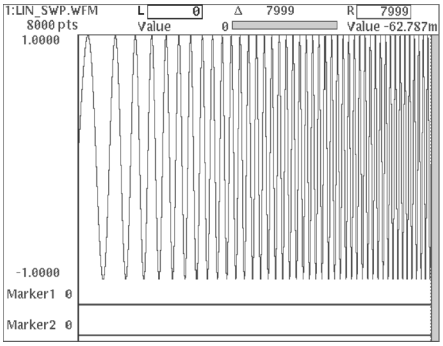
Table D-7: Nyquist pulse



File name	NYQUIST.WFM	Made with equation editor
Equation	clock = 1e9 size = 1024 k0 = 50e-9 'data period k1 = 512e-9 'peak location a = 0.5 'excess bandwidth factor 0 to 0.5 "t" = (time - k1) / k0 "nyquist.wfm" = cos(a * pi * "t") / (1 - (2 * a * "t") ^ 2) * sinc(pi * "t") delete ("t")	
Descriptions	This is the impulse response of a wave shaping Nyquist filter. The shoulder characteristics of this filter are referred to as "cosine roll–off" characteristics, and the bandwidth used can be varied. This waveform can be expressed by the following formula. $V(t) = \frac{\cos\left(\frac{\pi a t}{T}\right)}{1-\left(\frac{2at}{T}\right)^2} \cdot \frac{\sin\left(\frac{\pi t}{T}\right)}{\frac{\pi t}{T}}$ Here T is the data period and a is a value between 0 and 1. A wider band is required for values closer to 1, where ripple is reduced and implementation is easier.	
Settings	Waveform points: 1024, Clock frequency: 1.0 GHz, Output time: 1024 ns	

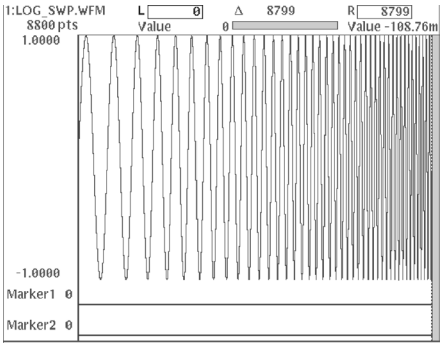
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Table D-8: Linear frequency sweep



File name	LIN_SWP.WFM	Made with equation editor
Equation	clock = 1e9 size = 8000 k0 = 8e-6 'sweep period k1 = 1e6 'start frequency k2 = 10e6 'end frequency "lin_swp.wfm" = sin(2 * pi * k1 * time + 2 * pi * (k2 - k1) * (time ^ 2)/2/k0)	
Descriptions	This waveform can be expressed generally by the following formula. $V(t) = \sin\left[2\pi f_1 t + 2\pi f_2 \int_0^t \frac{t}{T} dt + \phi_0\right]$ Here f_1 is the starting frequency, f_2 is the ending frequency, ϕ_0 is the initial phase, and T is the sweep period. To assure that the phases match when this waveform is iterated, the sweep period is set to be close to an integer multiple of the reciprocal of the average frequency $\frac{f_1 + f_2}{2}$.	
Settings	Waveform points: 8000, Clock frequency: 1.0 GHz, Output time: 8000 ns	

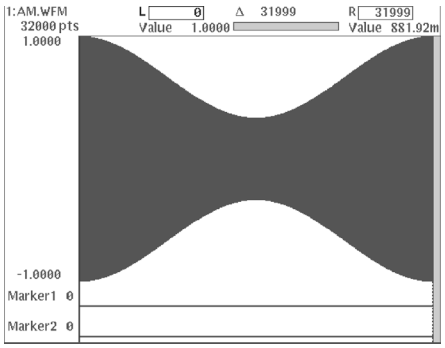
Table D-9: Log frequency sweep



File name	LOG_SWP.WFM	Made with equation editor
Equation	clock = 800e6 size = 8800 k0 = 11e-6 'sweep period k1 = 1e6 'start frequency k2 = 10e6 'end frequency k3 = log (k2 / k1) "log_swp.wfm" = sin(2 * pi * k1 * k0 / k3 * (exp (k3 * scale) -1))	
Descriptions	This waveform can be expressed generally by the following formula. $V(t) = \sin\left[2\pi f_1 \int_0^t exp\left(\frac{t}{T} \cdot In\frac{f_2}{f_1}\right) dt + \phi_0\right]$ Here f_1 is the starting frequency, f_2 is the ending frequency, ϕ_0 is the initial phase, and T is the sweep period. To assure that the phases match when this waveform is iterated, the sweep period is set to be close to an integer multiple of the reciprocal of the average frequency $\frac{f_2 - f_1}{In\frac{f_2}{f_1}}$.	
Settings	Waveform points: 8800, Clock frequency: 800 MHz, Output time: 11 µs	

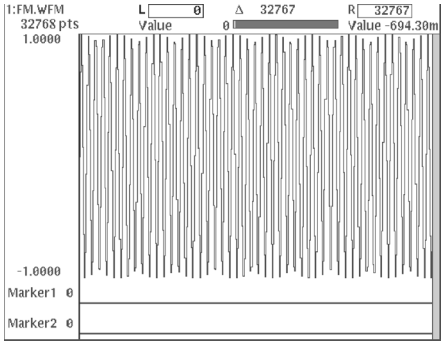
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Table D-10: Amplitude modulation



File name	AM.WFM	Made with equation editor
Equation	clock = 1.28e6 size = 32000 k1 = 4000 'modulation frequency k2 = 10e6 'carrier frequency a = 0.5 'modulation degree “am.wfm” = norm((1 + a * cos(2 * pi * k1 * time)) * cos(2 * pi * k2 * time)) delete (“tmp”)	
Descriptions	This example shows a double sideband (DSB) amplitude modulated waveform with a modulation factor of 0.5. The modulating signal is a cosine wave.	
Settings	Waveform points: 32000, Clock frequency: 128 MHz, Output time: 0.25 ms	

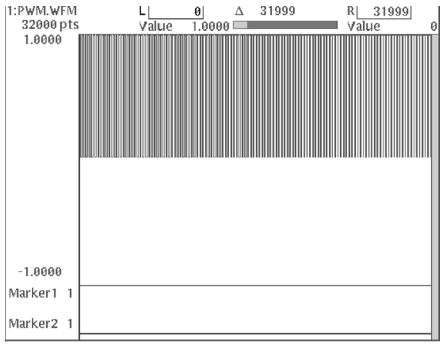
Table D-11: Frequency modulation



File name	FM.WFM	Made with equation editor
Equation	clock = 819.2e6 size = 32768 k0 = 25e3 'modulation frequency k1 = 100e6 'carrier frequency b = 60.12e3 'frequency deviation “fm.wfm” = sin(2 * pi * k1 * time + b / k0 * sin(2 * pi * k0 * time))	
Descriptions	k0 is the frequency of the cosine wave that is used to modulate a sine wave of frequency k1. To assure that the phases match when this waveform is iterated, the carrier frequency times the modulating signal period is set to be an integer. The modulation index is given by k2/k0.	
Settings	Waveform points: 32768, Clock frequency: 819.2 MHz, Output time: 40 μs	

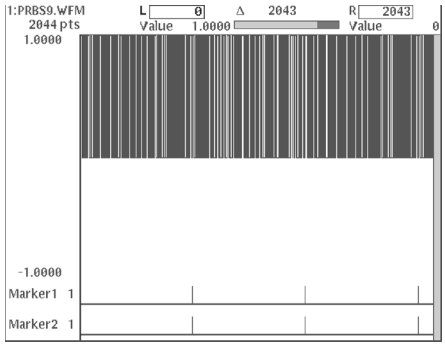
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Table D-12: Pulse width modulation



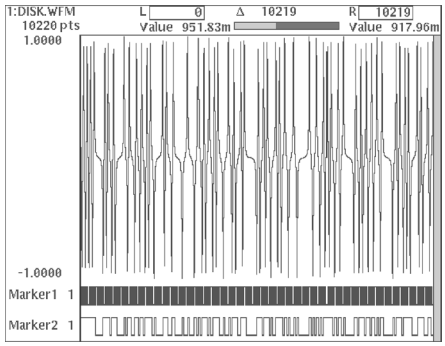
File name	PWM.WFM	Made with waveform editor
Descriptions	The waveform editor is used to create a ramp wave of 1000 periods and a sine wave of 1 period, and these two waveforms are compared to create the PWM.WFM waveform.	
Settings	Waveform points: 32000, Clock frequency: 1.0 GHz, Output time: 32 µs	

Table D-13: Pseudo–random pulse



File name	PRBS9.WFM	Made with waveform editor
Descriptions	An M–series pseudo–random signal is created using the waveform editor's timing display shift register generator function. Register length = 15 The encoding is NRZ.	
Settings	Waveform points: 4088 ($(2^9-1) \times 8$), Clock frequency: 2.0 GHz, Output time: 2.044 µs	

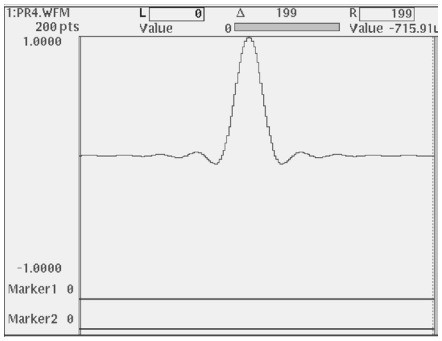
Table D-14: Waveform for magnetic disk signal



File name	DSK.WFM	Made with disk application
Descriptions	Creates a disk signal pattern with NRZ–I modulation using the disk application. This signal is created with default parameter settings.	
	Samples/Cell 20 NLTS 0% Cell Period 20 ns NLTS+ 0% TAA+ 1.0 NLTS- 0% TAA- -1.0 Asymmetry 0% PW50+ 50 % PW50- 50% The encoding is NRZ–I.	
	A signal with the same pattern is set for the marker 1 as well.	
Settings	Waveform points: 10220, Clock frequency: 1.0 GHz, Output time: 10220 ns	

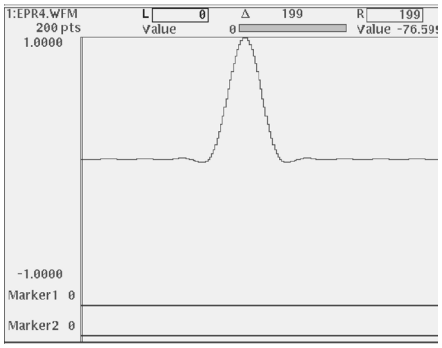
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Table D-15: Isolated pulse for disk application



File name	PR4.EQU	Made with equation editor
Equation	'PR4 Pulse spcell = 10 'Samples/Cell cperiod = 10e-9 'Cell Period [sec] ncells = 20 'Number of Cells clock = spcell/cperiod 'Samples/Cell / Cell Period [Hz] size = spcell*ncells 'Samples/Cell * Number of Cells k0 = ncells*pi 'Number of Cells * PI k1 = 0.5 a = pi/4 PR4.WFM = a * (sinc(k0*(scale-k1)) + sinc(k0*(scale-k1)+pi))	
Descriptions	This is the isolated pulse for the PR4. This sample equation makes the PR4.WFM waveform with 200 waveform points (Samples/Cell × Number of Cells).	
Settings		

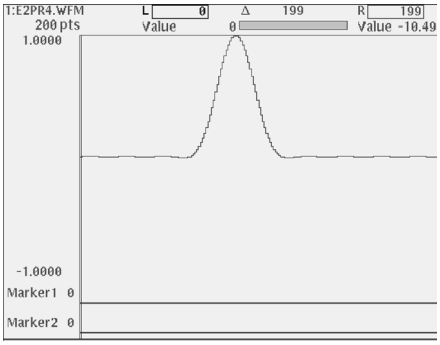
Table D-16: Isolated pulse for disk application



File name	EPR4.EQU	Made with equation editor
Equation	'EPR4 Pulse spcell = 10 'Samples/Cell cperiod = 10e-9 'Cell Period [sec] ncells = 20 'Number of Cells clock = spcell/cperiod 'Samples/Cell / Cell Period [Hz] size = spcell*ncells 'Samples/Cell * Number of Cells k0 = ncells*pi 'Number of Cells * PI k1 = 0.5 a = 0.5 EPR4.WFM = a * (sinc(k0*(scale-k1)) + 2*sinc(k0*(scale-k1)+pi) +sinc(k0*(scale-k1)+2*pi))	
Descriptions	This is the isolated pulse for the EPR4. This sample equation makes the EPR4.WFM waveform with 200 waveform points (Samples/Cell × Number of Cells).	
Settings		

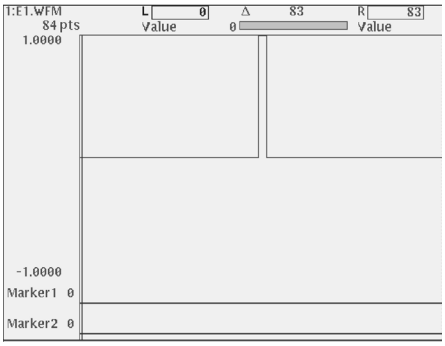
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Table D-17: Isolated pulse for disk application



File name	E2PR4.EQU	Made with equation editor
Equation	'E2PR4 Pulse spcell = 10 'Samples/Cell cperiod = 10e-9 'Cell Period [sec] ncells = 20 'Number of Cells clock = spcell/cperiod 'Samples/Cell / Cell Period [Hz] size = spcell*ncells 'Samples/Cell * Number of Cells k0 = ncells*pi 'Number of Cells * PI k1 = 0.5 a = pi*3/32 E2PR4.WFM = a * (sinc(k0*(scale-k1)) + 3*sinc(k0*(scale-k1)+pi) + 3*sinc(k0*(scale-k1)+2*pi) + sinc(k0*(scale-k1)+3*pi))	
Descriptions	This is the isolated pulse for the E2PR4. This sample equation makes the E2PR4.WFM waveform with 200 waveform points (Samples/Cell × Number of Cells).	
Settings		

Table D-18: Isolated pulse for network application



File name	E1.WFM	Made with waveform editor
Descriptions	This is the isolated pulse for the ITU-T E1. The number of waveform points is 84. This isolated pulse is applied to ITU-T E2, ITU-T E3, and T1.102 DS1C.	
Settings		

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Table D-19: Isolated pulse for network application

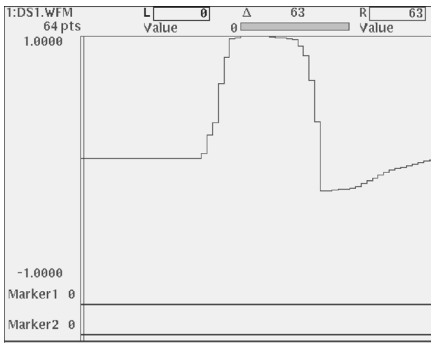
	**File name**	DS1.WFM	Made with waveform editor
	Descriptions	This is the isolated pulse for the T1.102 DS1. The number of waveform points is 64.	
	Settings		

Table D-20: Isolated pulse for network application

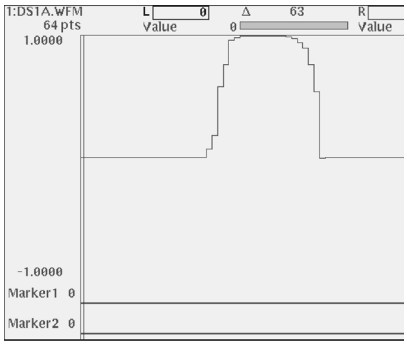
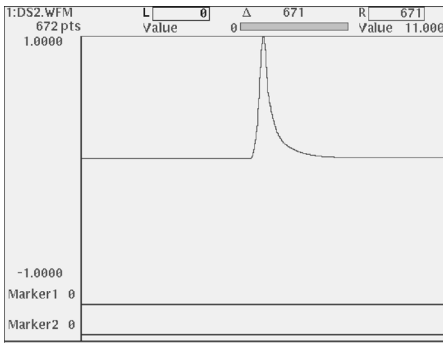
	**File name**	DS1A.WFM	Made with waveform editor
	Descriptions	This is the isolated pulse for the T1.102 DS1A. The number of waveform points is 64.	
	Settings		

Table D-21: Isolated pulse for network application

	**File name**	DS2.WFM	Made with waveform editor
	Descriptions	This is the isolated pulse for the T1.102 DS2. The number of waveform points is 672.	
	Settings		

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Table D-22: Isolated pulse for network application

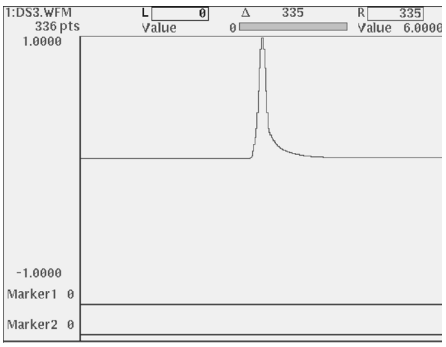
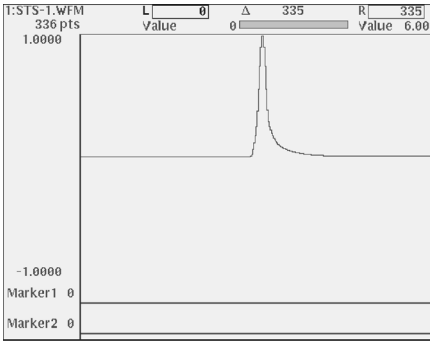
	**File name**	DS3.WFM	Made with waveform editor
	Descriptions	This is the isolated pulse for the T1.102 DS3. The number of waveform points is 336.	
	Settings		

Table D-23: Isolated pulse for network application

	**File name**	STS-1.WFM	Made with waveform editor
	Descriptions	This is the isolated pulse for the T1.102 STS-1. The number of waveform points is 336.	
	Settings		

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Appendix E: File Transfer Interface Outline

The AWG710&AWG710B Arbitrary Waveform Generator provides the following interfaces for file transfer:

- GPIB
- Floppy disk (FD)
- Ftp
- NFS (Network File System)

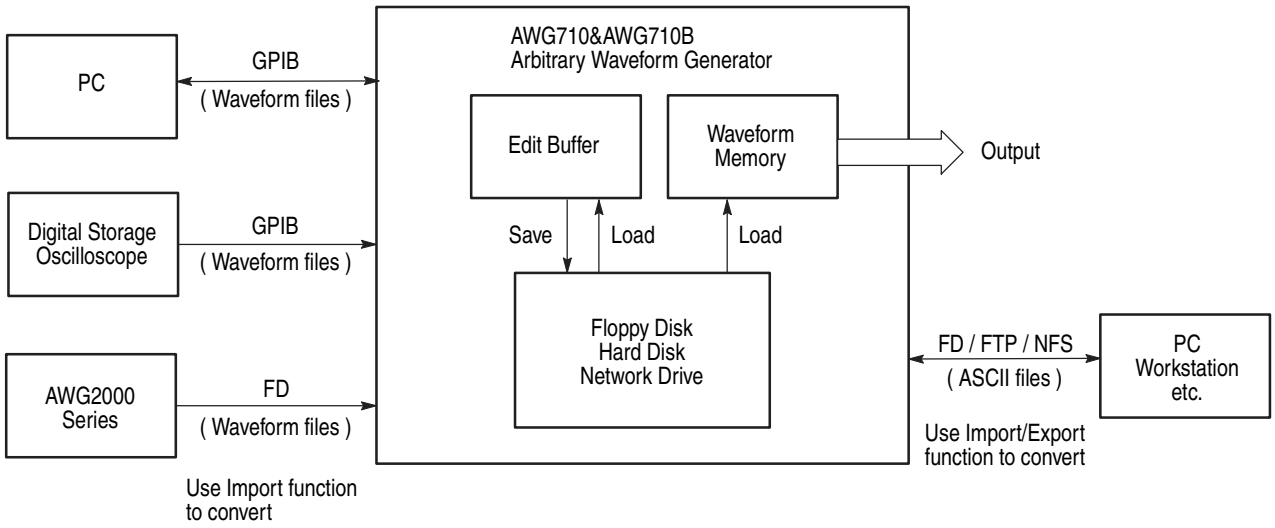


Figure E-1: File transfer interface outline

The AWG710&AWG710B Arbitrary Waveform Generator imports and/or exports files from/to external equipment such as PC, DSO, or AWG2000 Series.

Figure E-1 shows an outline for the interfaces and the file transfer direction.

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Appendix F: Miscellaneous

This appendix covers the following items.

- Sampling theorem
- Differentiation
- Integration
- Convolution
- Correlation
- Code Conversion

Sampling Theorem

When the signal is continuous and the highest frequency component of the signal is f_0, sampling with $T \leq 1/2f_0$ loses none of the data contained in the signal. T is the sampling interval. This theorem is well known as the sampling theorem. If data is created to meet this theorem, the necessary signal can be obtained.

$$X(t) = \sum_{n=-\infty}^{\infty} X(nt) \frac{sin\{(2\pi/T)(t-nT/2)\}}{(2\pi/T)(t-nT/2)}$$

A continuous analog signal x(t) can be reproduced from the digital data with the above equation. In the Waveform Generator, this is realized using a D/A converter.

Differentiation

The diff() function calculates the central deviation as the differential value. The equation below expresses the central deviation when the function f(x) is given at even intervals of Δx.

$$f'(x) = \frac{f(x+\Delta x) - f(x-\Delta x)}{(2\Delta x)}$$

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In actual practice, when function f(x)is expressed by n values, the differential value f'(x_i) at point x_i is given by the following equation:

$$f'(x_i) = n\frac{|f(x_{i+1}) - f(x_{i-1})|}{2}$$

Here, "n" is the number of waveform points and "i" is an integer in the range, i=1, 2, ..., n.

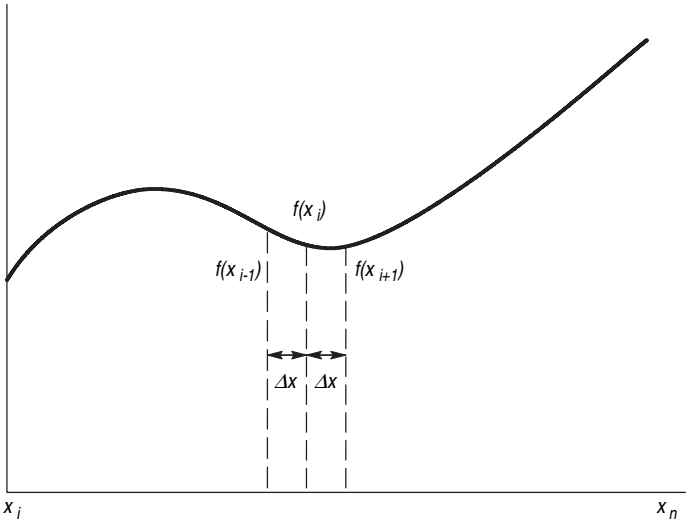


Figure F-1: Equation differentiation

The values at the first and last points are obtained from the following equations rather than from the center deviation:

First point

$$f'(x_1) = \frac{n|-3f(x_1) + 4f(x_2) - f(x_3)|}{2}$$

Last point

$$f'(x_n) = \frac{n|f(x_{n-2}) - 4f(x_{n-1}) - 3f(x_n)|}{2}$$

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Integration

The integ() function integrates numerically based on a trapezoidal formula. The trapezoidal formula is expressed with the following equation:

$$\int f(x)\,dx = \sum_{i=1}^{n} \frac{f(x_{i-1}) + f(x_i)}{2} \cdot \Delta x$$

$$= \Delta \frac{x}{2} \{\Delta f(x_1) + 2f(x_2) + 2f(x_3) + \ldots + 2f(x_{n-1}) + f(x_n)\}$$

Here, n is the number of waveform points and i is an integer in the range i = 1, 2, ..., n.

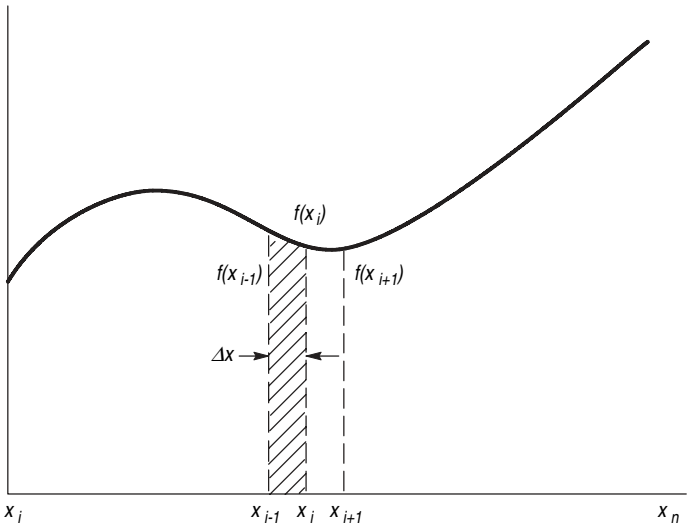


Figure F-2: Equation integration

The integration is actually calculated with the following formula:

$$\int f(x)dx = 1/2\{f(x_1) + 2f(x_2) + 2f(x_3) + \ldots + 2f(x_{n-1}) + f(x_n)\}$$

However, the imaginary initial value f(x_0) always takes a value of 0.

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Convolution

The operation expressed by the following equation is called convolution. With respect to a discrete system, convolution y(n) of a certain waveform x(n) and a second one h(i) is expressed by the following equation. N is the number of items of data.

$$y(n) = \sum_{i=0}^{N-1} x(i)h(n-i)$$

Periodic. The Periodic enables you to specify whether the two–waveforms must be regarded as periodic during calculation. Below is an example showing differences between non–periodic and periodic waveforms.

Waveform A = a0, a1, a2, a3, a4 (5 points)
Waveform B = b0, b1, b2 (3 points)

For nonperiodic case:

A*B = a0b0,
a0b1+a1b0,
a0b2+a1b1+a2b0,
a1b2+a2b1+a3b0,
a2b2+a3b1+a4b0,
a3b2+a4b1,
a4b2,
0, (8 points)

The data length of the waveform created is the total of the number of points of the two–waveform files.

For periodic case:

A*B = a0b2+a1b1+a2b0,
a1b2+a2b1+a3b0,
a2b2+a3b1+a4b0,
a3b2+a4b1+a0b0,
a4b2+a0b1+a1b0,
(5 points)

Waveforms A and B are regarded as periodic during calculation. The count of the operation of sum of products is equivalent to the length of the shorter waveform. The resulting waveform's cycle equals the same as the longer waveform. The actual output segment of the waveform corresponds to one cycle. The starting point value of the waveform equals the sum of products that is obtained with the starting point values of waveforms A and B added.

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Correlation

The operation expressed by the following equation is called correlation. With respect to a discrete system, correlation y(n) of a certain waveform x(n) and a second one h(i) is expressed by the following equation. N is the number of items of data.

$$y(n) = \sum_{l=0}^{N-1} x(i)h(n+1)$$

Periodic. Periodic enables you to specify whether the two–waveforms must be regarded as periodic during calculation. Below is an example showing differences between nonperiodic and periodic waveforms.

Waveform A = a0, a1, a2, a3, a4 (5 points)
Waveform B = b0, b1, b2 (3 points)

For nonperiodic case:

<A,B> = a0b2,
a0b1+a1b2,
a0b0+a1b1+a2b2,
a1b0+a2b1+a3b2,
a2b0+a3b1+a4b2,
a3b0+a4b1,
a4b0,
0, (8 points)

The data length of the waveform created is the total of the number of points of the two–waveform files.

For periodic case:

<A,B> = a0b0+a1b1+a2b2,
a1b0+a2b1+a3b2,
a2b0+a3b1+a4b2,
a3b0+a4b1+a0b2,
a4b0+a0b1+a1b2,
(5 points)

Waveforms A and B are regarded as periodic during calculation. The count of the operation of the sum of the products is equivalent to the length of the shorter waveform. The resulting waveform's cycle equals the same as the longer waveform. The actually output segment of the waveform corresponds to one cycle. The starting point value of the waveform equals the sum of products that is obtained with the starting point values of waveforms A and B added.

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Unlike convolution, the result of A×B and B×A are different in correlation. B×A is calculated as follows (B and A are those from the example on page F-5):

For nonperiodic case:

A×B = b0a4,
b0a3+b1a4,
b0a2+b1a3+b2a4,
b0a1+b1a2+b2a3,
b0a0+b1a1+b2a2,
b1a0+b2a1,
b2a0,
0, (8 points)

For periodic case:

A×B = b0a0+b1a1+b2a2,
b0a4+b1a0+b2a1,
b0a3+b1a4+b2a0,
b0a2+b1a3+b2a4,
b0a1+b1a2+b2a3,
(5 points)

Waveforms A and B are regarded as periodic during calculation. The count of the operation of sum of products is equivalent to the length of the shorter waveform. The resulting waveform's cycle equals the same as the longer waveform. The actual output segment of the waveform corresponds to one cycle. The starting point value of the waveform equals the sum of the products that is obtained with the starting point values of waveforms A and B added.

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Code Conversion

On the AWG710&AWG710B Arbitrary Waveform Generator, it is possible to select the coding system used when pattern strings are output. If the code will be affected by the immediately preceding data, the data item just before the first item of data will be calculated as 0. The following tables show the coding systems.

Using the code conversion table, bit pattern can be converted to another code. Figure F-3 shows an image of how the code conversion table is used.

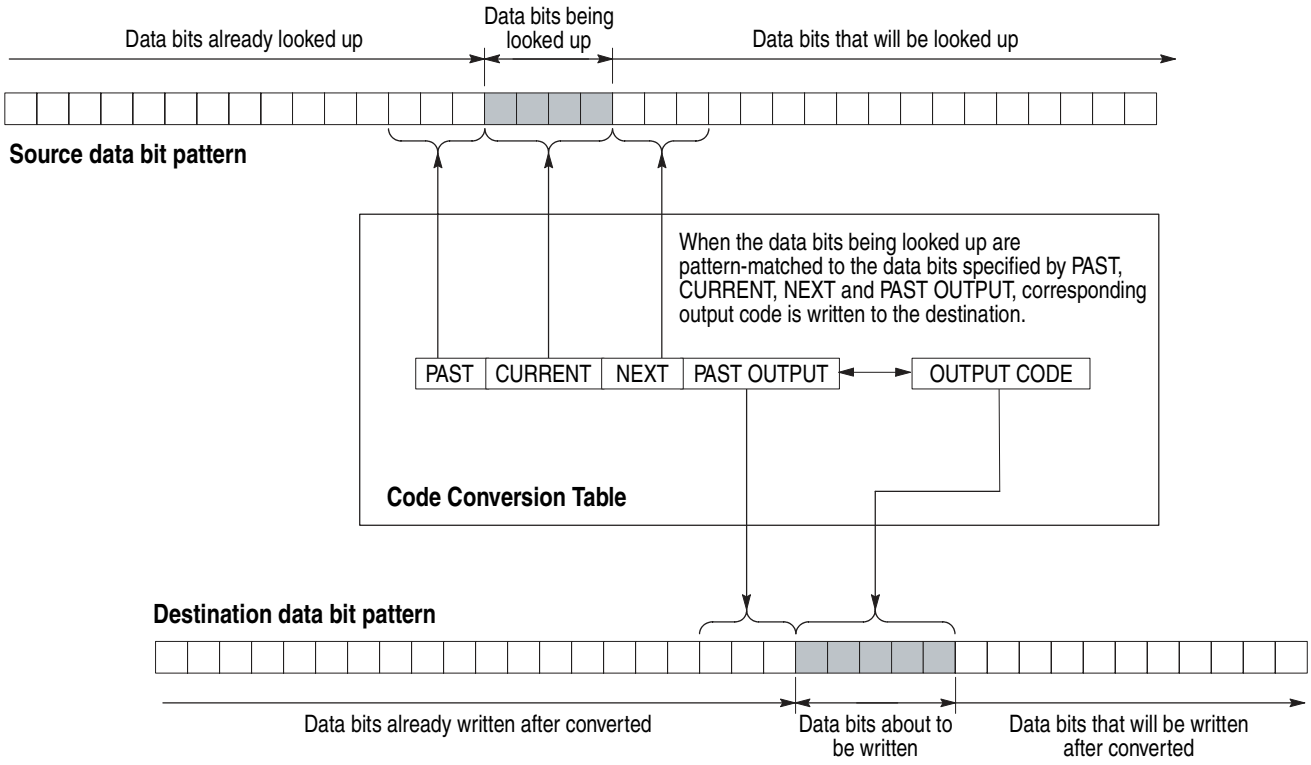


Figure F-3: Conversion image example

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Examples

The following examples show data bits to be written. Input and output data bit pattern example follows each table.

- Inverting bit of the **NRZ** data.

Past	Current	Next	P.OUT	Output code
	0			1
	1			0

Example									
Input	0	1	0	0	1	1	0	0	0
Output	1	0	1	1	0	0	1	1	1

- Converting NRZ data to **NRZI**.

Past	Current	Next	P.OUT	Output code
	1		0	1
	1		1	0
	0		0	0
	0		1	1

Example									
Input	0	1	0	0	1	1	0	0	0
Output	0	1	1	1	0	1	1	1	1

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- Converting NRZ data to **NRZI**. Two bits are generated for each input bit.

Past	Current	Next	P. OUT	Output code
	1		0	01
	1		1	10
	0		0	00
	0		1	11

Example									
Input	0	1	0	0	1	1	0	0	0
Output	00	01	11	11	10	01	11	11	11

- Converting NRZ data to **FM**. Two bits are generated for each input bit.

Past	Current	Next	P. OUT	Output code
	0		0	11
	0		1	00
	1		0	10
	1		1	01

Example									
Input	0	1	0	0	1	1	0	0	0
Output	11	01	00	11	01	01	00	11	00

- Converting NRZ data to **BI–PHASE**. Two bits are generated for each input bit.

Past	Current	Next	P. OUT	Output code
	0			01
	1			10

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Example									
Input	0	1	0	0	1	1	0	0	0
Output	01	10	01	01	10	10	01	01	01

- Converting NRZ data to **RZ**. Two bits are generated for each input bit.

Past	Current	Next	P. OUT	Output code
	0			00
	1			10

Example									
Input	0	1	0	0	1	1	0	0	0
Output	00	10	00	00	10	10	00	00	00

- The output bit is always set to 1 when input bit changes from 1 to 0 or 0 to 1.

Past	Current	Next	P. OUT	Output code
0	1			1
1	0			1
	1			0
	0			0

Example									
Input	0	1	0	0	1	1	0	0	0
Output	0	1	1	0	1	0	1	0	0

- Converting NRZ data to **1–7 RLL** (Run–length Limited Codes).

Past	Current	Next	P. OUT	Output code
	0000		1	100000
	0000		0	011111
	0001		00	111111

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Past	Current	Next	P. OUT	Output code
	0001		01	111111
	0001		10	000000
	0001		11	000000
	0010		01	111110
	0010		10	000001
	0010		00	111110
	0010		11	000001
	0011		1	100001
	0011		0	011110
	01		1	100
	01		0	011
	10		01	111
	10		10	000
	10		00	111
	10		11	000
	11		01	110
	11		10	001
	11		00	110
	11		11	001
	0			0
	1			1

Example											
Input	01	10	11	0010	10	0011	11	0001	0011	10	0000
Output	011	000	110	000001	111	100001	110	000000	011110	000	011111

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Code Conversion Table Text Files

The code conversion table is only a text file. You can easily create the code conversion tables using a text editor on your PC or other computer. Refer to pages 3-88 and 3-134 for more information.

nrz.txt	nrzi.txt	nrzi–2.txt
,0,,,1 ,1,,,0	,1,,0,1 ,1,,1,0 ,0,,0,0 ,0,,1,1	,1,,0,01 ,1,,1,10 ,0,,0,00 ,0,,1,11
fm.txt	**bi–phase.txt**	**rz.txt**
,0,,0,11 ,0,,1,00 ,1,,0,10 ,1,,1,01	,0,,,01 ,1,,,10	,0,,,00 ,1,,,10
special.txt	**1–7rill.txt**	
0,1,,,1 1,0,,,1 ,1,,,0 ,0,,,0	,0000,,1,100000 ,0000,,0,011111 ,0001,,00,111111 ,0001,,01,111111 ,0001,,10,000000 ,0001,,11,000000 ,0010,,01,111110 ,0010,,10,000001 ,0010,,00,111110 ,0010,,11,000001 ,0011,,1,100001 ,0011,,0,011110 ,01,,1,100 ,01,,0,011 ,10,,01,111 ,10,,10,000 ,10,,00,111 ,10,,11,000 ,11,,01,110 ,11,,10,001 ,11,,00,110 ,11,,11,001 ,0,,,0 ,1,,,1	

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Appendix G: Sequence File Text Format

The sequence file saved by the sequence editor is an ASCII text file having the format described below. You can create a sequence file on a PC or other computer with an ASCII text editor.

```
MAGIC 3002A
LINES <number>
<line description>
<line description>
       ...
<line description>
TABLE_JUMP 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
LOGIC_JUMP -1,-1,-1,-1
JUMP_MODE LOGIC
JUMP_TIMING ASYNC
STROBE 0
```

Header

The header line MAGIC 3002A lets the instrument recognize a text file as the sequence. This number must be added to the first line.

Line Descriptions

The LINES provides the information that the sequence is composed of a number of lines. From the third line to the line specified by <number> +2 are the sequence lines you should edit in the in the sequence editor.

The <line description> is composed of 6 fields delimited by comma (,):

```
<F1>, <F2>, <F3>, <F4>, <F5>, <F6>, <F7>
```

CH1 and CH2. The <F1> is a waveform file name for the CH1 and <F2> for the CH2. The waveform file name must be parenthesized with double–quotation.

```
<F1>::=
<F2>::="<waveform file name>" | "<pattern file name>" |
            "<sequence file name>"
```


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For example,

```
"SINE.WFM", "TRIANGLE.WFM", ...

"GAUSSN.WFM", "", ...

"", "TRIALGLE.WFM", ...
```

When you do not define a file, NULL string (””) must be placed.

Repeat Count. The <F3> is Repeat Count field.

```
<F3>:=<Repeat Count>|<Infinity>

   <Repeat Count>::= 1 to 65536
   <Infinity>::= 0
```

Enhanced Controls. The <F4> to <F7> are Repeat Count, Wait Trigger, Goto One, Logic Jump, and Goto <N> respectively.

```
<F4>::=<Wait Trigger>

   <Wait Trigger>::= 1 (On)
                     0 (Off)

<F5>::=<Goto One>

   <Goto One>::= 1 (On)
                 0 (Off)

<F6>::=<Logic Jump>

   <Logic Jump>::= <Line Number> (range: 1 to 8000)
                   0 (No definition)
      -1 (Jump to next line)
      -2 (Table Jump)
```

Note that the Logic Jump setting is effective depending on the jump settings described in next paragraph.

```
<F7>::=<Goto N>

   <Goto N>::= <Line Number>    (Jump to line n, range: 1 to
   8000)
                   0       (Go to next line)
```


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Jump Settings

After the line descriptions, you place the jump setting descriptions as follows: They can be omitted when you use the current settings.

```
TABLE_JUMP 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
LOGIC_JUMP -1,-1,-1,-1
JUMP_MODE LOGIC
JUMP_TIMING ASYNC
STROBE 0
```

Jump Table Definition. The 16 entries of the table definition follow the table jump header TABLE_JUMP and a space, and must be delimited by comma (,):

```
TABLE_JUMP <space> <LLLL>, <LLLH>, <LLHL>, <LLHH>, <LHLL>,
<LHLH>, <LHHL>, <LHHH>, <HLLL>, <HLLH>, <HLHL>, <HLHH>, <HHLL>,
<HHLH>, <HHHL>, <HHHH>
```

Each of these entries must be:

```
<Entry>::= <Line Number> (range: 1 to 8000)
           0 (No definition)
```

Logic Jump Definition. The 4 entries of the logic table definition follow the logic jump header LOGIC_JUMP and a space, and must be delimited by comma (,):

```
Logic Jump <space> <PinÐ0 logic>, <PinÐ1 logic>,
<PinÐ2 logic>, <PinÐ3 logic>

   <PinÐn logic>::= -1 (for X, don´t care),
                    0 (for L, low state) or
                    1 (for H, high state)
```

Jump Mode Selection. The jump table or logic jump definition you define is effective depending on the jump mode setting as follows:

```
JUMP_MODE <space> <jump mode>

   <jump mode>::= TABLE, LOGIC or SOFTWARE
```

Jump Timing and Strobe Settings.

```
JUMP_TIMING <space> <timing>

   <timing>::= SYNC or ASYNC

STROBE <space> <strobe>

   <strobe>::= 0 (for Off) or
               1 (for On)
```


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Examples

Two examples are shown here. They are the text versions of the sequence files that you can find in the *Operating Basics: Tutorial 6* section, beginning on page 2-70.

SUBSEQ.SEQ.

```
MAGIC 3002A
LINES 4
"SQUARE.WFM", "", 40000, 0, 0, 0, 0
"RAMP.WFM", "", 60000, 0, 0, 0, 0
"TRIANGLE.WFM", "", 60000, 0, 0, 0, 0
"SINE.WFM", "", 30000, 0, 0, 0, 0
TABLE_JUMP 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
LOGIC_JUMP -1, -1, -1, -1,
JUMP_MODE LOGIC
JUMP_TIMING ASYNC
STROBE 0
```

Using the current instrument default settings, you can rewrite the above file as follows:

```
MAGIC 3002A
LINES 4
"SQUARE.WFM", "", 40000
"RAMP.WFM", "", 60000
"TRIANGLE.WFM", "", 60000
"SINE.WFM", "", 30000
```

MAINSEQ.SEQ.

```
MAGIC 3002A
LINES 4
"SUBSEQ.SEQ","",2,1,0,0,0
"RAMP.WFM","",0,0,0,-1,0
"TRIANGLE.WFM","",40000,0,1,4
"SINE.WFM","",60000,0,0,0,0
TABLE_JUMP 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
LOGIC_JUMP -1,-1,-1,-1
JUMP_MODE LOGIC
JUMP_TIMING ASYNC
STROBE 0
```


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