User Manual

Tektronix

DG2030
Data Generator

071-0059-50

This document applies to firmware version 1.00 and above.

www.tektronix.com

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WARRANTY

Tektronix warrants that the products that it manufactures and sells will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If a product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use.

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the Product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:

WARNING
High Voltage

Protective Ground
(Earth) Terminal

CAUTION
Refer to Manual

Double
Insulated

Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, disconnect the mains power by means of the power cord or, if provided, the power switch.

Use Caution When Servicing the CRT. To avoid electric shock or injury, use extreme caution when handling the CRT. Only qualified personnel familiar with CRT servicing procedures and precautions should remove or install the CRT.

CRTs retain hazardous voltages for long periods of time after power is turned off. Before attempting any servicing, discharge the CRT by shorting the anode to chassis ground. When discharging the CRT, connect the discharge path to ground and then the anode. Rough handling may cause the CRT to implode. Do not nick or scratch the glass or subject it to undue pressure when removing or installing it. When handling the CRT, wear safety goggles and heavy gloves for protection.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

X-Radiation. To avoid x-radiation exposure, do not modify or otherwise alter the high-voltage circuitry or the CRT enclosure. X-ray emissions generated within this product have been sufficiently shielded.

Preface

The User Manual for the DG2030 Data Generator contains the following sections.

Getting Started covers the features of the DG2030, initial inspection, options and accessories, installation procedures, and power on and off procedures. In particular, the installation section covers the procedures required prior to turning on the unit and areas of the instrument that require special care or caution.

Operating Basics introduces DG2030-specific terminology and provides an overview of the instrument internal structure, operating principles, basic operating procedures, and numeric input methods. This section also provides basic signal editing examples.

Reference describes in detail the functions and use of the DG2030 main menus.

Appendices describe product specifications, performance verification instructions, and other information.

Related Manuals

Other documentation for the instrument includes:

- The *DG2030 Programmer Manual* (Tektronix part number 071-0057-XX) explains how to control the DG2030 with a computer through the GPIB or RS-232-C interface. This manual is a standard accessory.
- The *DG2030 Service Manual* (Tektronix part number 071-0058-XX) describes how to maintain and service the DG2030, and provides a complete module-level description of the instrument operation. This manual is an optional accessory.

Conventions

The following typographical conventions are used in this manual.

- Names of front panel controls and menu item names are in bold with the same case (initial capitals or all upper case) as they appear on the unit itself. For example, **SETUP**, **Sub-sequence**.
- Sections 2, 3, and Appendix B describe instrument functions by using a table to list a sequence of steps. Each operating procedure is presented in order starting with step 1, and progresses until the end of the procedures. Execute the action in the top-left table entry first. Then execute actions from left to right along each row. When you are done executing the steps in one row, move to the left end of the next row down, and continue executing the listed steps until the end of the table.

  For pop-up menus, use the general-purpose knob to select items from the menu list. Operations such as operation 6 (below) do not involve pressing the buttons shown in the row above, but rather are descriptions of operations to be performed.

Menu button	Bottom button	Popup menu	Side button	Front panel button
Operation 1	Operation 2	Operation 3	Operation 4	Operation 5
Operation 6 (for example, 'Use the general-purpose knob to set cursor field to 128.')				
			Operation 7	

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com
Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* 6:00 a.m. – 5:00 p.m. Pacific time

* **This phone number is toll free in North America. After office hours, please leave a voice mail message.**
Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.

Getting Started

This section provides the following information:

- Description and features of the DG2030
- Initial inspection
- Standard and optional accessories
- Installation procedures
- Power on and off procedures

Product Description

The DG2030 is a portable digital data generator designed for high performance and ease of use. The DG2030 is easy to use for testing and evaluating semiconductors and logic circuits, which are continually becoming faster and more complex.

The DG2030 provides high performance and a wide range of functions in a compact package. The DG2030 includes the following features:

- Maximum data rate of 400 MHz
- 256 K word pattern memory
- Flexible sequence looping (which does the equivalent of over a billion word patterns)
- 4 channels (with support for up to 8 channels by adding an optional module)
- For each output channel:
  - Variable output levels (from –1.5 to +3.5 V, into 50 Ω)
  - 10 pS timing skew adjustment function
  - Pulse rise and fall time setting (for 2 V p-p or higher output level)
  - Delay setting (20 ps resolution)

Any memory size from 90 words to 256 K words can be used easily, with no restrictions within that range. Each of 8 bit data channels can be assigned to any output channel. Output channels support setting of high and low output voltage levels, rise and fall time, delay time, and output stages to a high-impedance state.

The DG2030 also provides a 4000-step sequence controller, which enables the generation of not only a data pattern longer than the pattern memory but also dynamic pattern change triggered by external events.

The DG2030 provides flexible data editing functions, including word and line unit input and extended data creation functions. Also, the DG2030 provides a rich set of functions required for system construction, such as a sequencing function, a jump function using external input, and an inhibit function.

Features

The following list just a few of the many features of the DG2030:

- The DG2030 supports subassembly and system testing by simulating the digital signals from incomplete sections of a product.
- Logic function test systems can be constructed by combining this instrument with a logic analyzer.
- Margin tests can be performed by using the DG2030 to generate patterns that have a low probability of occurrence or are difficult to generate.
- Interactive digital simulation systems can be constructed using the sequence output, external jump, and tri-state control functions.
- Flexible data output functions make the DG2030 an ideal data generator for simulation of LCD display units, CCD line and area sensors, and all types of digital circuits.

Initial Inspection

Before unpacking the DG2030 from its shipping carton, inspect the package for signs of external damage. If the carton is damaged, notify the carrier. The carton contains the instrument and its standard accessories. Refer to the Standard Accessories list in Section 1.

This instrument was thoroughly inspected for mechanical and electrical defects before shipment. It should be free of dents or scratches. To confirm this, inspect the instrument for physical damage that happened in transit, and test instrument functionality, by following the Operating Examples in this manual. You can also perform a full Performance Verification as listed in Appendix B. If a discrepancy is found, contact your local Tektronix Field Office or representative.

***NOTE**. Save the shipping carton and packaging materials for repackaging in case shipment becomes necessary.*

Options

This section describes the options, and standard and optional accessories available for the DG2030.

The following options are available:

Option 01 (8-channel output)
Option 1R (Rack mounting)

Each of these options will be discussed in detail in the following paragraphs.

Option 01 (8-Channel Output)

This option adds 4 output ports for a total of 8 channels. Contact your Tektronix sales representative if you intend to add this option to a DG2030 that you are already using.

Option 1R (Rack Mount)

When option 1R is specified, the DG2030 is shipped configured for mounting in a 19-inch rack. The floppy disk drive is moved so that it can be accessed from the front panel in this instrument. Contact your Tektronix sales representative for details on converting a non-rack mounting DG2030 to rack mounting.

See the instruction sheet provided with the rack mounting kit for details on the rack mounting adapter.

Power Cord Options

Table 1-1 lists the power cords available with the DG2030.

Table 1-1: Power cord options

Option	Description	Part number
A1	Europe, 220 V/6A	161-0104-06
A2	United Kingdom, 240 V/6A	161-0104-07
A3	Australia, 240 V/6A	161-0104-05
A4	North America, 240 V/6A	161-0104-08
A5	Switzerland, 220 V/6A	161-0167-00

Accessories

Standard Accessories

Table 1-2 lists the standard accessories provided with the DG2030.

Table 1-2: Standard accessories

Standard accessory	Part number
User Manual (this manual)	071-0059-XX
Programmer Manual	071-0057-XX
Performance Check Disk, 3.5-inch	063-2922-XX
GPIB Sample Program Disk, 3.5-inch	063-2921-XX
DG-LINK Application Program Disk, 3.5-inch	063-2920-XX
Power cord 125 V/6A	161-0230-01
Certificate of Calibration	

Optional Accessories

Table 1-3 lists the optional accessories that are recommended for use with the DG2030.

Table 1-3: Optional accessories

Optional accessory	Part number
Service Manual	071-0058-XX
Front Cover	200-3232-XX
Accessory Pouch	016-1159-XX
Rackmount kit	040-1444-XX
Fuse 6A Fast (UL198G/3AG)	159-0239-XX
Fuse cap	200-2264-XX
Fuse 5A (T) (IEC127)	159-0210-XX
Fuse cap	200-2265-XX
GPIB Cable	012-0991-XX
50 Ω BNC Cable, 2m	012-1342-XX
50 Ω BNC Cable (Double shield)	012-1256-XX
50 Ω SMB Cable, 1 m	012-1458-XX
50 Ω BNC to SMB Cable, 1 m	012-1459-XX
50 Ω termination	011-0049-02
50 Ω BNC Power Divider	015-0660-XX
Output Cable, 50 Ω SMB to Pin-header Cable, 50 cm	012-1503-XX
Output Cable, 50 Ω SMB to Pin-header Cable, 127 cm	012-1506-XX
Adaptor, 50 Ω SMB to BNC	015-0671-XX
Lead Set, 1 ch lead set (set of 5) [1]	012-1508-XX
Lead Set, 4 ch lead set (set of 3) [1]	012-1509-XX

1 Used to provide the flexible connection for output signal and grounding by attaching to the pin-header end of the 50 Ω cable (SMB to pin header or pin header to pin header).

Installation

Before installation, refer to the Safety Summary at the front of this manual for power source, grounding, and other safety information.

Before you use the instrument, ensure that it is properly installed and powered on. To properly install and power on the instrument, perform the following steps:

1. Check that the operating environment is correct.

The DG2030 operates correctly in ambient temperatures from +10° C to +40° C and relative humidity from 20% to 80%. If the instrument is stored at temperatures outside this usage temperature range, do not switch on the power until the chassis has come within the operating temperature range. For more operating environment information, refer to Appendix A, *Specifications*.

***NOTE**. If you are installing the instrument in the dedicated rack, refer to the instruction sheet that comes with the rack mounting kit.*

2. Before switching on the power, double check that there is nothing blocking the flow of air at the fan and air intake holes.

the instrument takes in outside air and cools itself by forcibly exhausting air with the fan on its left side. Leave space at the sides of the instrument so that the heat generated within the instrument does not build up and harm the operation. There are holes for air intake on the sides and bottom of the cabinet. After switching on the power, double check that the fan is turning. Here are the minimums for the space at the sides of the instrument.

Top and bottom : 2.5 cm (1 inche)
Left and right : 15.0 cm (6 inches)
Rear : 7.5 cm (3 inches)

***WARNING.** Always unplug the power cord from the socket before checking the line fuse.*

3. Remove the fuse from the fuse holder on the rear panel and check the fuse.

To remove the fuse, turn it counter-clock-wise with a screwdriver while pushing it in. There are two types of fuses provided. Here is the fuse type and rating.

Fuse	Fuse part number	Fuse cap part number
0.25 inch × 1.25 inch (UL 198G,3AG) : 6A FAST, 250 V	159-0239-XX	200-2264-XX
5 mm × 20 mm (IEC 127) : 5A (T), 250 V	159-0210-XX	200-2265-XX

***NOTE**. The second fuse listed in the table above is approved under the IEC standards. This fuse is used in equipment sold in the European market.*

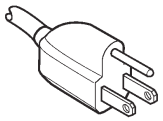
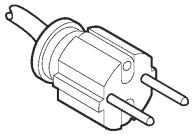
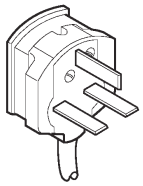
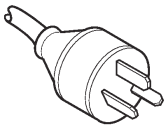
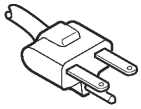
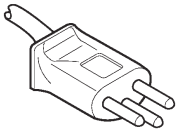
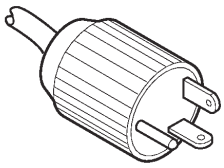
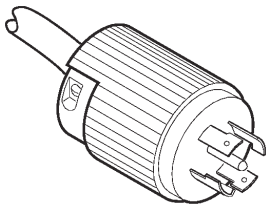
4. Check that you have the proper electrical connections. The DG2030 operates within the following power supply voltage and frequency ranges:

Line voltage range	90 V – 250 V
Line frequency	48 Hz – 440 Hz (90 V – 127 V) 48 Hz – 63 Hz (127 V – 250 V)
Maximum power	300 W

***CAUTION.** The DG2030 is shipped with a power cord appropriate for use with normal 115 V power systems. If the DG2030 is to be used with 230 V power, the power cord must be replaced with one appropriate for the power source used. See* Table 1-4, Power cord identification*, for the available power cord types.*

5. Connect the proper power cord from the rear panel power connector to the power system.

Table 1-4: Power cord identification

Plug configuration	Normal usage	Option number
	North America 125 V	Standard
	Europe 230 V	A1
	United Kingdom 230 V	A2
	Australia 230 V	A3
	North America 230 V	A4
	Switzerland 230 V	A5
	North American 115 V/15A Plug NEMA 5-20P	1A
	North American 120/208 V 3-Phase Plug NEMA L21-30P	1B

Standby Power

6. Push the **PRINCIPAL POWER SWITCH** (shown in Figure 1-1) on the rear panel of the instrument. Power is now applied to the standby circuit of the instrument. Once the instrument is installed, leave the **PRINCIPAL POWER SWITCH** on and use the **ON/STBY** switch as the power switch.

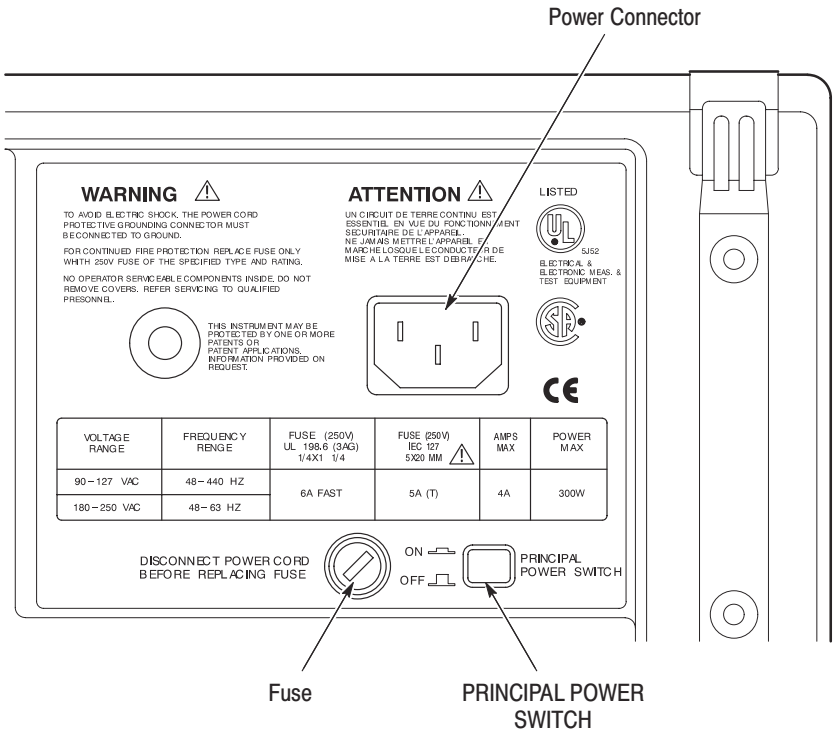


Figure 1-1: Rear panel power switch, fuse holder, and connector.

Power On

7. Press the **ON/STBY** switch (shown in Figure 1-2) on the lower left side of the front panel to switch on the power for the instrument.

***NOTE**. the instrument needs to be warmed up for at least 20 minutes and then be calibrated for the clock in order to operate at its optimum precision.*

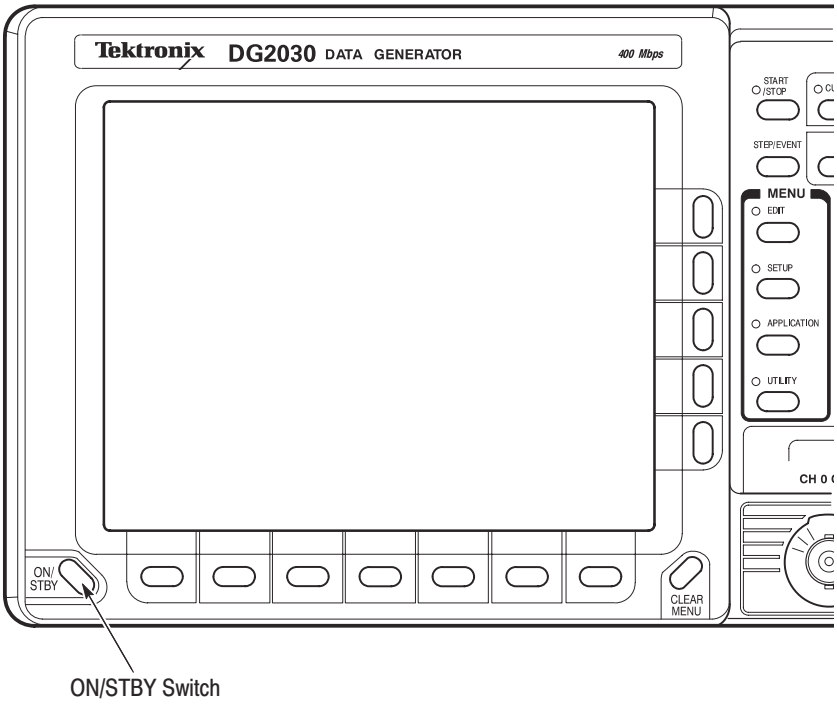


Figure 1-2: Location of the ON/STBY switch

Start-up Diagnostics

8. The DG2030 automatically runs diagnostics when the instrument is turned on from the ON/STBY switch. These diagnostics check whether the instrument is performing within its defined operating characteristics. If all the diagnostic items have been completed without error, the instrument displays the EDIT menu.

If an error is detected, the instrument displays a fail and error code message. You can exit this state by pressing any front-panel button to display the EDIT menu. However, until the error is corrected, the instrument performance cannot be relied on.

If the instrument chassis temperature is outside the specified operating range, an error will occur during the power-up diagnostics. If this happens, turn off the instrument, wait until the chassis temperature is within normal operating range, and then switch the power on again.

***NOTE**. Contact your local Tektronix Field Office or representative if an error is displayed.*

Power Off

To power off the DG2030, press the **ON/STBY** switch.

Operating Basics

This section provides the following information:

- An overview of the instrument controls and their functions.
- An overview of the DG2030 hardware.
- Operations commonly performed on the instrument and how to enter numbers.
- Simple examples showing how to edit, save, and recall pattern data.

Functional Overview

This section describes the terminology and functions of the DG2030 front, side, and rear panel controls. This section also describes the terminology and content of representative screen displays.

Front Panel

Figure 2-1 shows the layout of the DG2030 front panel. Figure 2-2 describes each front-panel control in detail.

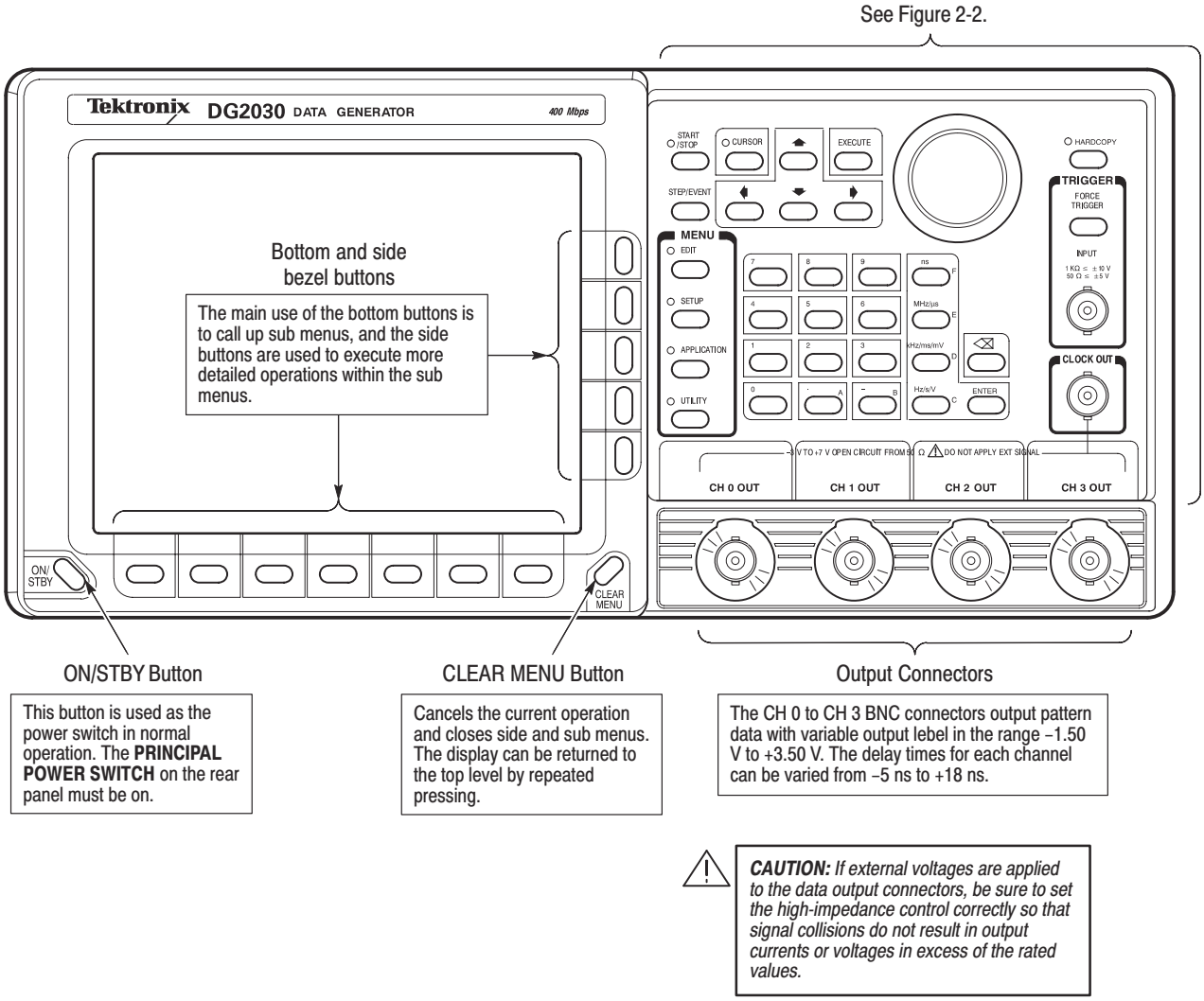


Figure 2-1: Front panel overview

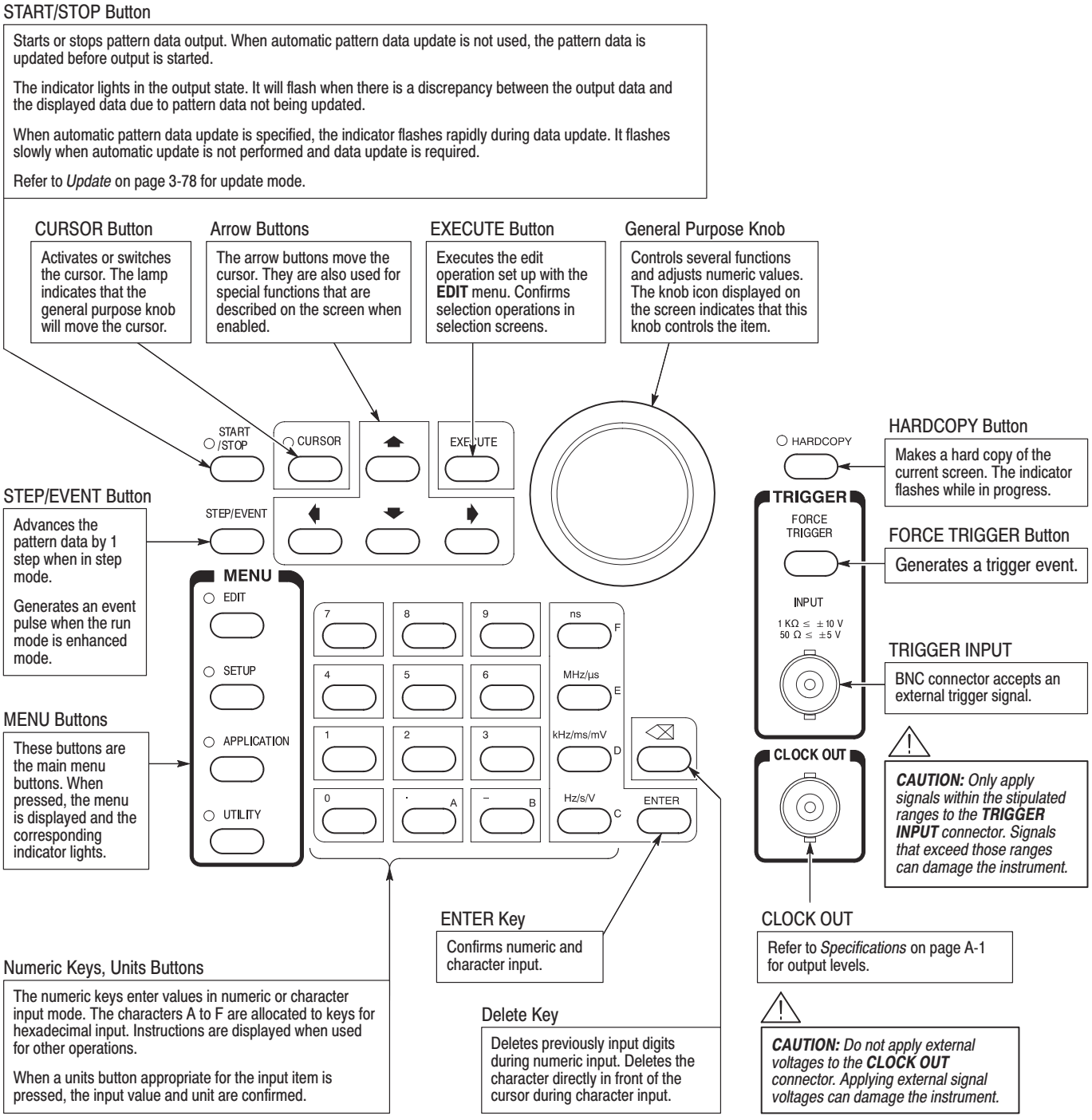


Figure 2-2: Front panel controls

Rear Panel Figure 2-3 shows the rear panel signal and power connectors.

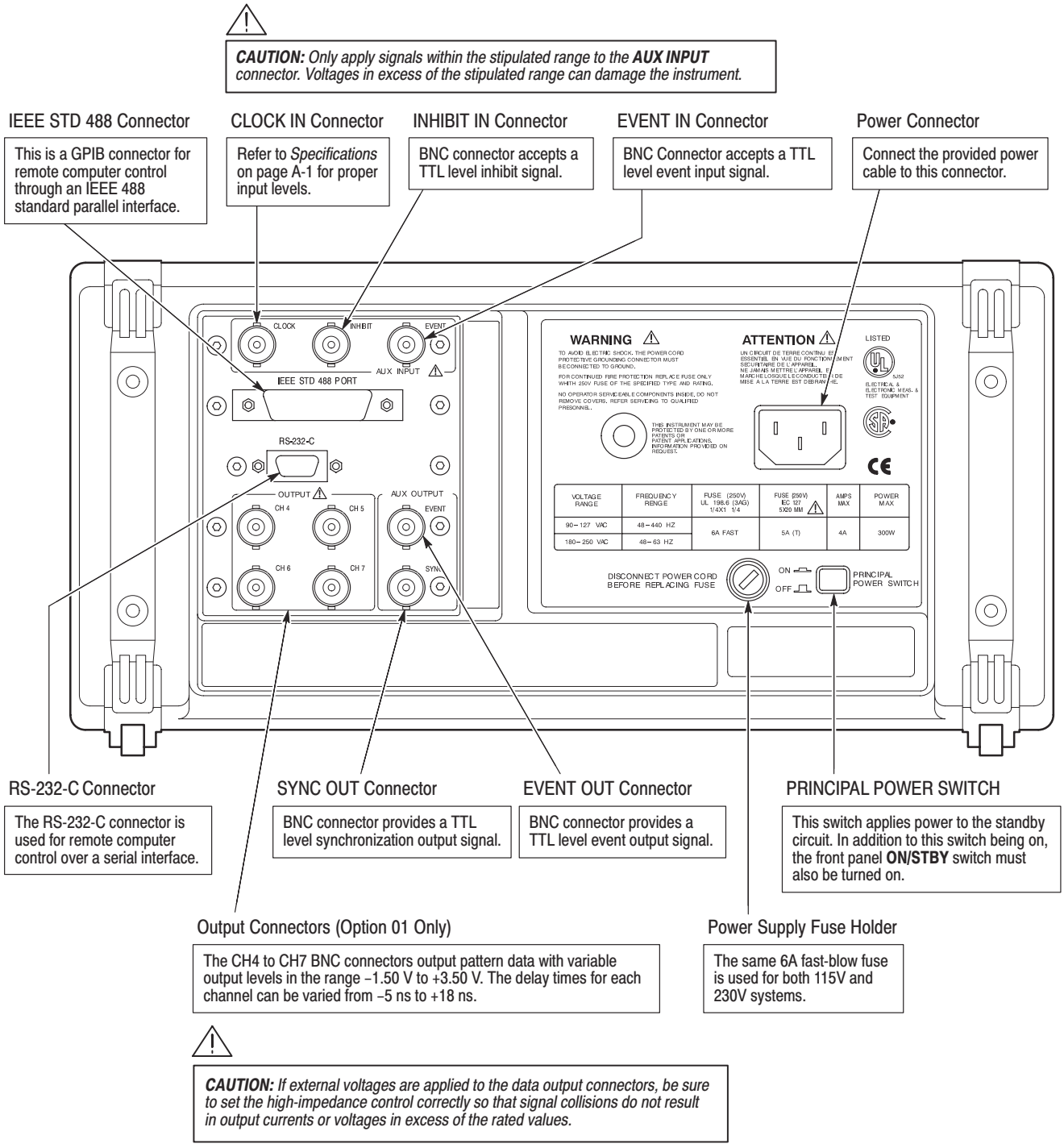


Figure 2-3: Rear panel connectors

Floppy Disk Drive

Figure 2-4 shows the floppy disk drive controls and indicators. The floppy disk drive is located on the right side of the DG2030 chassis. You use the floppy disk drive to save and recall instrument pattern and setting data.

CAUTION. *Do not press the eject button while the DG2030 is writing to the floppy disk. Doing so can cause data corruption on the floppy disk.*

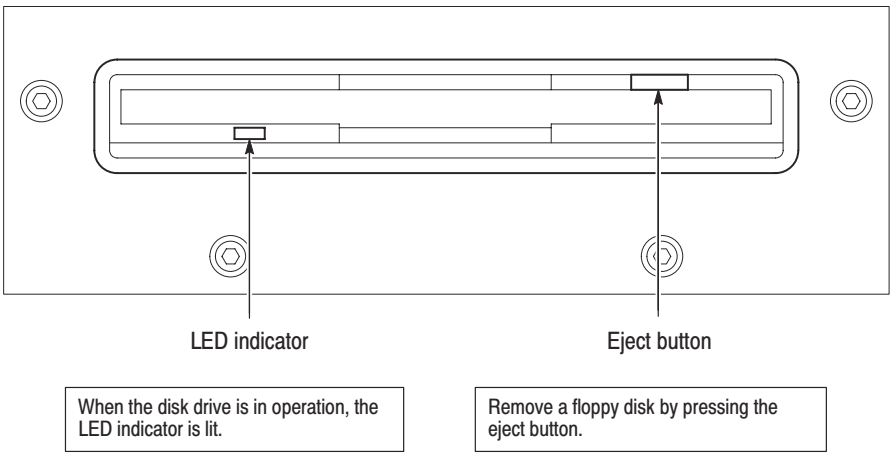


Figure 2-4: Floppy disk drive

Display Elements

Figure 2-5 shows the display elements, including bottom and side menus, work area, status lines, and so on. Also shown are a popup menu and message box. Table 2-1 describes each element in detail.

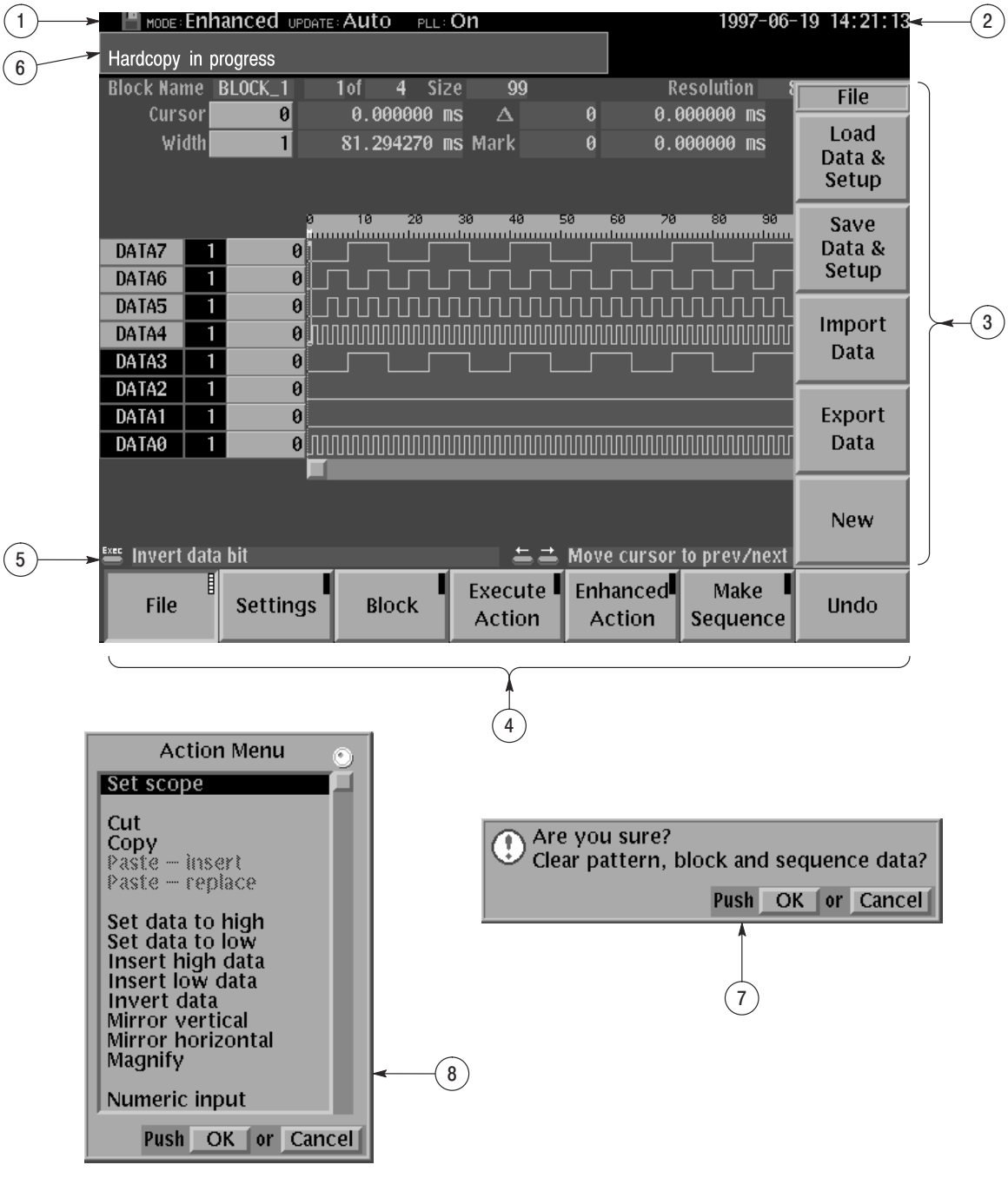


Figure 2-5: Display elements

Table 2-1: DG2030 display elements

Figure number	Label	Description	Page
1	Status area	Displays the current status of the instrument. This status line is always displayed, whichever menu is displayed. The status line displays the following four items.	
		MODE: Displays the run mode in which pattern data will be output.	3-75
		UPDATE: Displays the update method for pattern data output when data is updated.	3-78
		PLL: Displays whether or not the PLL circuit is used as the internal oscillator circuit.	3-82
		In addition, there is also a disk icon that indicates whether or not a floppy disk is inserted in the disk drive. A clock icon may also be displayed at the left end of the status line. When this icon is displayed, the instrument is busy with internal processing and cannot accept other inputs.	
2	Date and Time display area	The date and time display can be turned on or off using the UTILITY menu.	3-91
3	Side menu	Related side menu items are displayed here when a bottom menu item is selected. The topmost entry in the side menu displays either a label representing the side menu or the operation name for the confirmed item.	
4	Bottom menu	When one of the buttons in the menu section is pressed, the corresponding bottom menu is displayed. When a bottom menu item is selected the corresponding side menu is displayed. Selecting the same bottom menu item again closes the side menu.	
5	Button function description area	Displays descriptions of the functions of the front panel buttons.	
6	Message display area	Displays messages that report on the current processing state. This area can be also used by remote commands to display user messages.	
7	Popup message box	When required, the instrument temporarily displays a window at the center of the screen to display a warning or question for the user.	
8	Popup menu	The instrument sometimes displays a pop-up menu when a bottom menu or side menu item is selected. Enter a numeric value or select an item using either the general purpose knob or the front panel buttons.	

Theory of Operation

This section presents an overview of the DG2030 hardware, data structures, and operating modes to allow you to take full advantage of the DG2030.

Block Diagram

Figure 2-6 shows the main hardware blocks that make up the instrument. This section describes these hardware blocks to provide the background knowledge necessary to use the instrument effectively.

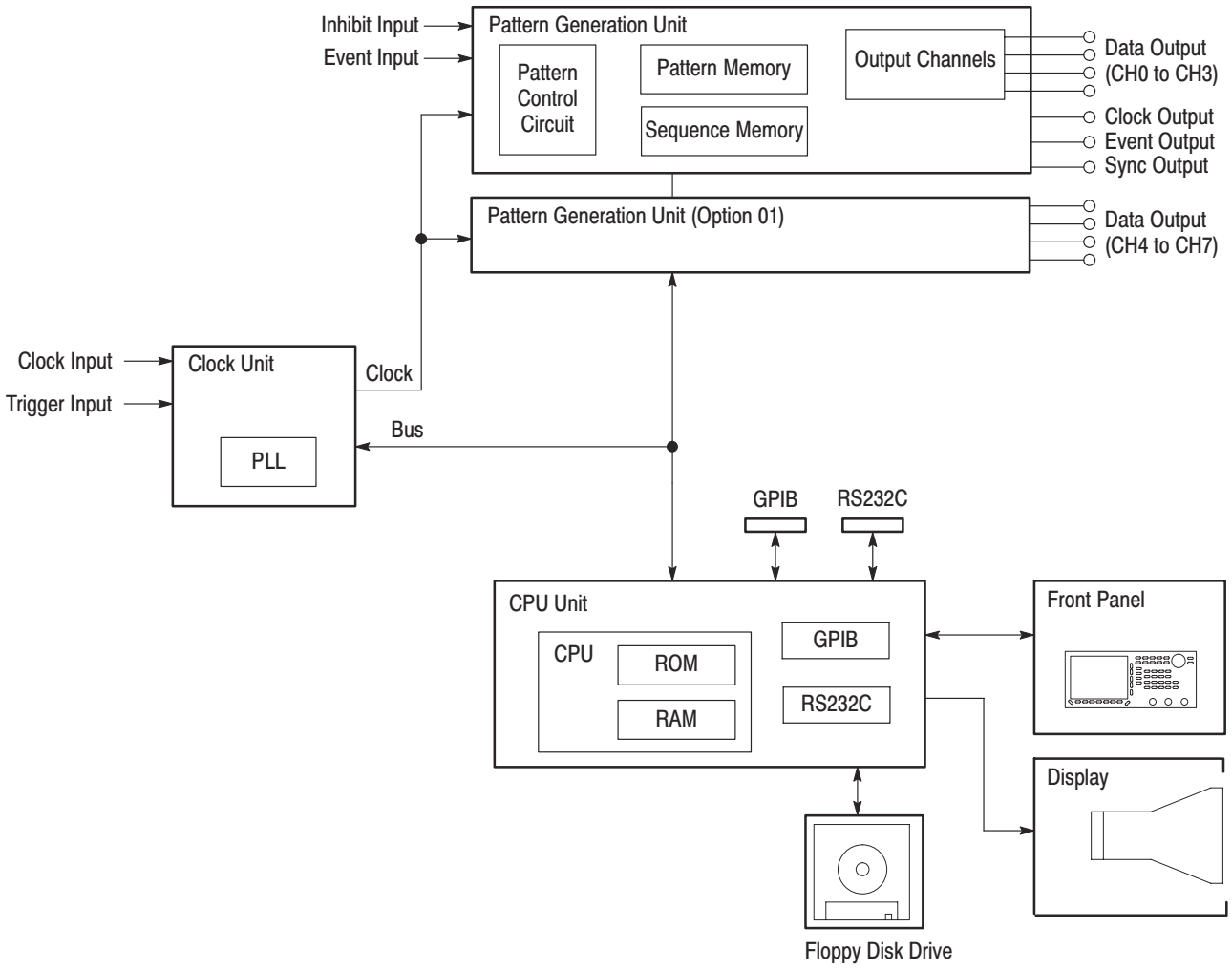


Figure 2-6: Hardware block diagram

CPU Unit

The CPU unit controls the instrument. The CPU unit includes ROM, RAM, and an I/O interface.

The ROM memory holds the program code that implements all the supported functions. The ROM contents are loaded at the factory.

The RAM memory holds a variety of information required by the CPU. The contents of RAM change according to the instrument's operating state. Since the contents of RAM are retained by a built-in battery even when the instrument is turned off, the main instrument settings will still be in effect the next time the instrument is turned on. The pattern data memory and the sequence data memory, which are described later as a conceptual data model, are actually stored in one section of this RAM.

External interfaces include GPIB and RS-232 interfaces for remote control, a floppy disk drive controller, and a user interface consisting of the display and the front panel.

Pattern Generation Unit

The pattern generation unit generates digital pattern signals based on the pattern data and sequence data specified by the user. This unit includes a pattern control circuit, pattern memory, and sequence memory.

Pattern memory and sequence memory are high-speed memories that hold the pattern data and sequence data, which are described later in this section. These memories supply pattern data to the pattern control circuit.

Clock Unit

The clock unit generates the clock signals that generate the data patterns. It also detects and synchronizes external trigger signals.

You can select whether the phase-lock-loop (PLL) circuit is used in clock signal generation or not. When the PLL circuit is used (PLL on), the clock unit generates a clock signal synchronized to an internal crystal oscillator. This provides an output with excellent frequency precision. When the PLL circuit is not used (PLL off), the clock unit can generate a clock output synchronized with an external trigger signal, although the frequency precision is lower. The PLL circuit can be turned on or off depending on the application.

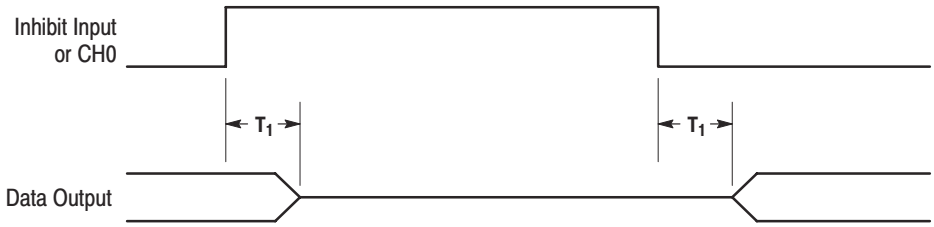
Output Channels

The output channels provide variable output levels and digital signals to the device under test.

The output channels level-convert the pattern signals from the pattern generation unit to output signals appropriate for the device under test. They also handle fine adjustment of specific bit timing.

Inhibit Function

The output channels support a function that sets their outputs to the high-impedance state. Inhibit level and inhibit control can be set, as parameters, for each output channel. For all channels, the external or internal inhibit signal, or the logical OR of those two signals can be selected as the high-impedance control signal. Channel 0 controls the internal inhibit.



T_1: The delay time from an external inhibit input or a CH0 signal until the corresponding data output goes to the high-impedance state, or the delay from the high-impedance state until high- or low-level data is available. Refer to Figure A-2 on page A-5 for more information.

Figure 2-7: Inhibit Operation Timing

Display and Front Panel

The display and front panel implement the user interface.

The display is a 16-level monochrome 640 × 480 pixel CRT. The front panel consists of menu buttons, numeric keys, bezel buttons, a general-purpose knob for changing numeric values and item selection, and several signal output connectors.

Data Structure Overview

To make full and efficient use of the DG2030, you need to understand the DG2030 data structures. This section presents an overview of the pattern data, setup data, and sequence data. Figure 2-8 shows the DG2030 data structures that are described in the following sections. Table 2-2 lists the data structure related technical terms that appear frequently in the operating procedure descriptions.

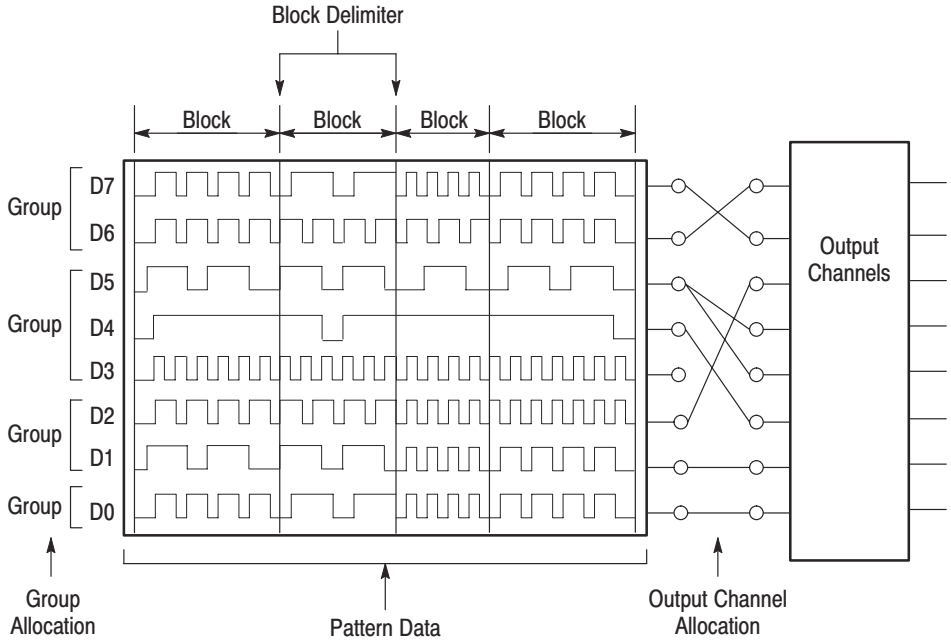


Figure 2-8: Data structures

Table 2-2: Data structure terms

Term	Meaning
Pattern data	Basic data for patterns, consisting of 8-bit words
Memory size	The number of pattern data words (90 to 256 K words)
Group allocation	Definitions of pattern data bit combinations
Block delimiter	Delimiter that defines pattern data start and stop points
Block division	Pattern data division by block delimiters
Output channel allocation	Definition of the correspondence relation ship between pattern data and output bits
Setup data	Settings for the above items
Sequence data	Pattern output sequence program

Pattern Data

Pattern data is the basic data that defines the digital signals to be output. The pattern data is a collection of 8-bit words. The total number of words is called the memory size. The memory size can be any value from a minimum of 90 words to a maximum of 256 K words (262,144).

Once pattern data has been transferred to the pattern memory in the pattern generation unit hardware it can actually be output as digital signals. Pattern memory consists of 8-bit words, with the 8 bits in a one-to-one correspondence with the 8 output channels. The definition of the relationship between pattern data bits and pattern memory bits is called output channel allocation.

The pattern data to pattern memory transfer operation is either performed automatically each time the data is modified, or you can manually cause the transfer to occur. This is called the data update mode, and it can be selected by user.

Setup Data

There are a large number of settings that define data structures and relationships between data items and that specify output channel states and other parameters. These settings are collectively referred to as the setup data. Since this data is associated with the pattern data, it is handled together with the pattern data in operations such as saving instrument settings and data to a floppy disk.

The setup data includes a wide range of settings, including output voltage levels, slope of edge, delay, high impedance control, clock frequency and PLL settings in addition to the definitions described here.

Groups

Although each bit in the pattern data can be defined independently, it is easier to edit and display data if multiple bits are collected and handled as a single group. Any set of bits can be assigned as a group. However, the bits assigned to a group must be adjacent to each other. For example, D0 through D3 can be assigned into a group, but D0, D1, and D5 can not (D1 and D5 are not adjacent).

Blocks

Pattern data can be divided into blocks. A block is a user-specified range of pattern data identified with a unique label. Blocks are divided by setting delimiters called block delimiters. Block delimiters are set in word units. Sequences, which are described later, control data output in block units.

Sequence Data

The sequence data is a program that specifies the order in which the pattern data is output. The sequence data is used to set up operations such as iteratively putting out blocks of pattern data for a specified number of times, and jumping to a specified block when an external event occurs. Sequences allow long patterns to be set up without preparing large quantities of data.

Sequences can include other sequences (called subsequences) so that you can make complex sequence program easier. Sequence data is transferred to the pattern generation unit sequence memory, and controls the operation of the pattern control circuit. Using the run mode, which is described in detail later, you can select whether all the sequence data is valid or whether enhanced mode settings such as event jumps in the sequence are ignored.

Operating Modes Overview

Run Modes

In the run modes, pattern output is controlled by the pattern generation unit's pattern control circuit. The DG2030 supports four run modes: repeat, single, step, and enhanced. These run modes are specified with the **SETUP → Run Mode** menu. Table 2-3 provides functional information for each mode.

Table 2-3: Run modes

Run mode	Function
Repeat	Repeats the pattern data from the first to last data point indefinitely. If a sequence is defined, iterates the output according to that sequence.
Single	Outputs the pattern data once from the first to last data point in point order. If a sequence is defined, outputs the pattern once according to that sequence.
Step	Operates identically to repeat mode, except that just one data point is output each time the **STEP/EVENT** button is pressed.
Enhanced	Same as Repeat with the addition that event jumps and trigger waits are also effective.

***NOTE**. The Repeat, Single, and Step modes ignore the event jump and trigger wait settings.*

Update Modes

When pattern data or sequence data is created or edited, or the output channel allocations are changed, the pattern that is actually output will not be updated until the new settings are transferred to the pattern generation unit.

There are two update methods: auto and manual. The update modes are set up with the **Update** item in the **SETUP → Run Mode** menu. Table 2-4 provides functional information for both modes.

Table 2-4: Update modes

Update mode	Function
Auto	Changes are reflected in the hardware as soon as they are entered.
Manual	Changes are reflected in the hardware when specified by you.

NOTE. *The response to edit operations while in Auto mode may be slow when there is a large amount of data being edited. In such cases, it is more efficient to perform a number of edit operations and then update the output data in manual mode.*

Basic Menu Operation

This section describes the DG2030 menu system and numeric input methods.

Menu Operations

The instrument's menu system is used for instrument settings, instrument operation, and pattern data output parameter selection. Pressing one of the menu buttons at the center of the instrument's front panel displays one of the menus that forms the basis of DG2030 operation. There are four menu buttons, **EDIT**, **SETUP**, **APPLICATION**, and **UTILITY**, as shown in Figure 2-9.

The menu items displayed on the screen are selected by pressing the corresponding bottom or side bezel button. The bezel buttons consist of seven bottom buttons and five side buttons, as shown in Figure 2-9.

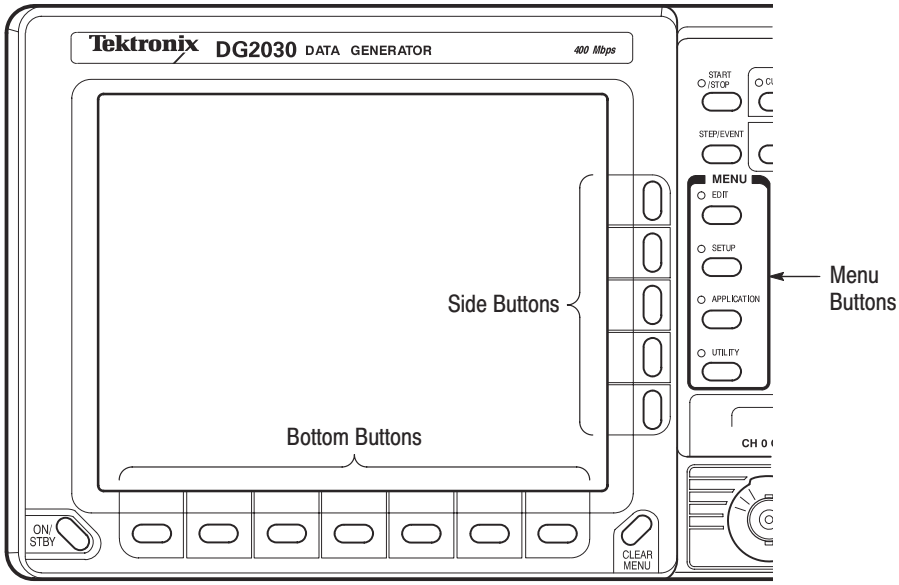


Figure 2-9: Menu and bezel buttons

When the target menu item is selected, the selection items and numeric input entries controlled by that menu are displayed. Items can be selected or numeric values changed using the numeric keys and the general purpose knob.

Selecting a menu item causes one of the following operations:

- A lower level menu is invoked.
- An item is selected:
  - The selected item changes each time a bezel button is pressed.
  - A list is displayed and an item is selected from that list.
- Numeric input is enabled.
- The function associated with the menu item is executed as soon as the menu item is selected.

Menu Notation

The following notation is used in this manual to show the order to push instrument buttons:

> Front panel menu button → Bottom menu button → [Side menu button or popup menu item]

The menu path starts with a front panel menu button, followed by an arrow (→), and then a bottom menu. The item in parenthesis may be repeated more than once, as needed. For example, **SETUP → Output Condition → Control Condition → Change Inhibit Control → Both → OK** is executed as follows:

1. Press the **SETUP** button on the front panel.
2. Press the **Output Condition** bottom button.
3. Press the **Control Condition** side button.
4. Press the **Change Inhibit Control** side button.
5. Select **Both** from the popup menu.
6. Press the **OK** side button.

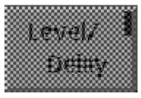
Menu Item Display

Starting with each main menu, the instrument displays bottom, side, and sub menu items according to fixed rules.

Bottom Menu

The bottom menu change according to whether items are selected or not, and whether an item is valid or not, as shown in Table 2-5.

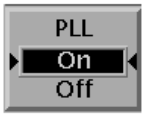
Table 2-5: Bottom menu elements

Menu item	Description
	Menu item in the unselected state. The small box in the upper right corner is black.
	Menu item in the selected state. The small box in the upper right corner is white.
	Menu item that cannot be selected since it is invalid in the current state.

Side and Sub Menus

The menu items that are manipulated with the side buttons, can be classified according to the manipulations they support. These menu items can be differentiated visually as shown in Table 2-6.

Table 2-6: Side and sub menu elements

Menu Item	Description	Menu item	Description
	Menu items that execute a function immediately		Menu items that call up sub menus
	Menu items that switch between on and off each time the side button is pressed.		Menu items that allow selections to be made with the general purpose knob
	Menu items that allow numeric values to be set using the numeric keys or the general purpose knob		Menu items that cannot be used in the current instrument state

Numeric Input

You enter numeric values by using the front-panel keypad or the general purpose knob. This section describes these numeric input methods.

Front-Panel Keypad

The numeric keys, the units buttons, the delete key and the **ENTER** key are used for entering numeric values. See Figure 2-10.

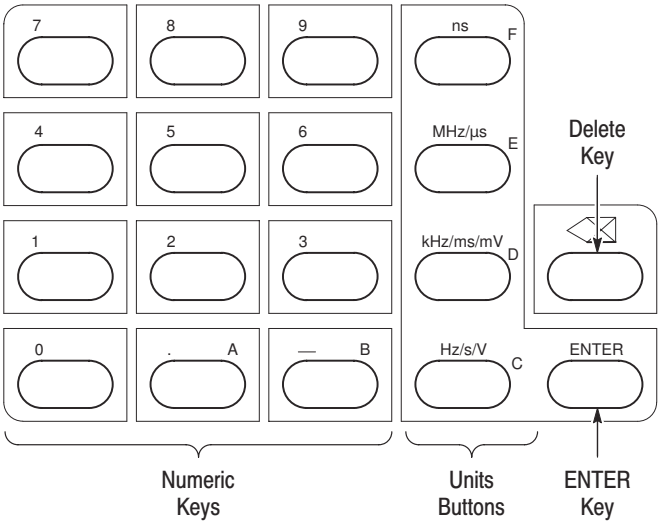


Figure 2-10: DG2030 front-panel keypad

Using the Keypad

Use the following procedure to input numeric values with the numeric keys, **ENTER** key, and units buttons on the front panel.

1. Press the button for the menu item to be changed.
2. Input the value using the numeric keys.
3. Press a units button or the **ENTER** key.

Figure 2-11 shows a menu display during numeric input. The asterisk to the left of the menu items indicates that you are entering a value in that field. Pressing the front panel **ENTER** key confirms an entered value and removes the asterisk from the menu item field.

Figure 2-11: Numeric entry in a menu item field

Numeric Input Example

This example shows how to change the clock frequency to 12.3 Hz when the value before entering the input state was 100.0 Hz. When the **1**, **2**, **.**, **3**, and **ENTER** keys are pressed in that order, the numeric input box changes as shown in Table 2-7.

Table 2-7: Numeric input example

Press keys in this order	Numeric input window display	State of the value
	100 Hz	Pre-numeric input
1	* 1	Numeric input in progress
2	* 12	
.	* 12.	
3	* 12.3	
ENTER	12.30000 Hz	Value confirmed

Pressing a units button after a value has been entered confirms both the value and the unit in a single operation. Pressing a units button before entering the input state changes only the unit without changing the value.

If you switch to another menu item after entering a value but without pressing either the **ENTER** key or a units button, the entered value is discarded and the value returns to its previous value. If a value outside the allowable range of a parameter is set, the value will be replaced with the largest or smallest value allowable for that parameter.

Setting Values with the General Purpose Knob

The general purpose knob and the left and right arrow buttons can be used to set values in numeric input boxes. The knob icon is displayed close to the box to show that you can use the general purpose knob to enter values. The general purpose knob is used to increase or decrease the value of the digit indicated by the underscore. Rotating the knob to the left decreases the value and rotating it to the right increases the value. Figures 2-12 and 2-13 show the general–purpose knob, the arrow keys, and the appearance of a menu element that can use the general purpose knob to enter numeric values

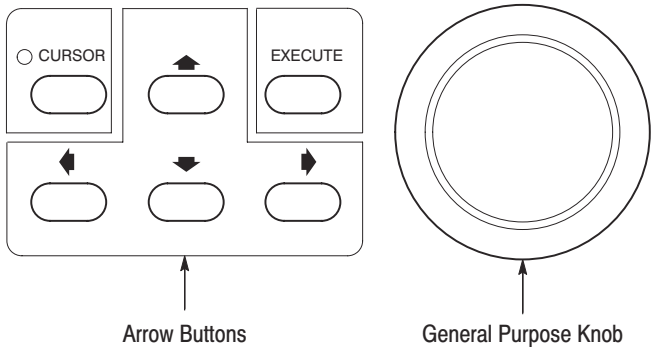


Figure 2-12: General purpose knob and arrow buttons

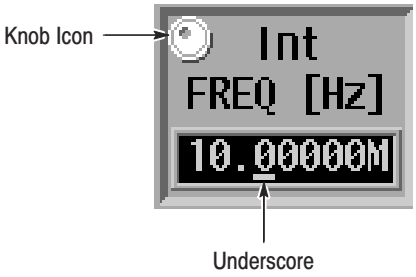


Figure 2-13: Menu element knob icon and underscore

You do not need to use the front panel **ENTER** key to confirm a value when using the general purpose knob to change a value. The input value is confirmed automatically without pressing the **ENTER** key.

Use the following procedure to change a value with the general purpose knob.

1. Press the button for the menu item to be changed.
2. Use the left and right arrow buttons to move the underscore line to the digit to be modified.

   The front panel arrow buttons control the amount of change that can be achieved with the general purpose knob. Pressing the ◀ button moves the underscore one digit to the left and thus multiplies the effect of turning the general purpose knob by ten. Inversely, pressing the ▶ button moves the underscore one digit to the right and reduces the effect of turning the general purpose knob by a factor of ten.
3. Change the value by turning the general purpose knob.

Pattern Data Display Format

You can display pattern data in one of three formats: timing display, table display, and binary display. Use the **EDIT → Settings** item to select the display format. Figures 2-14 through 2-16 show the three display formats.

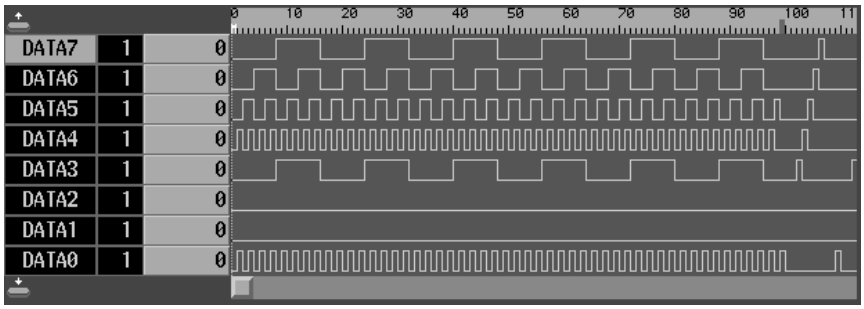


Figure 2-14: Timing display format

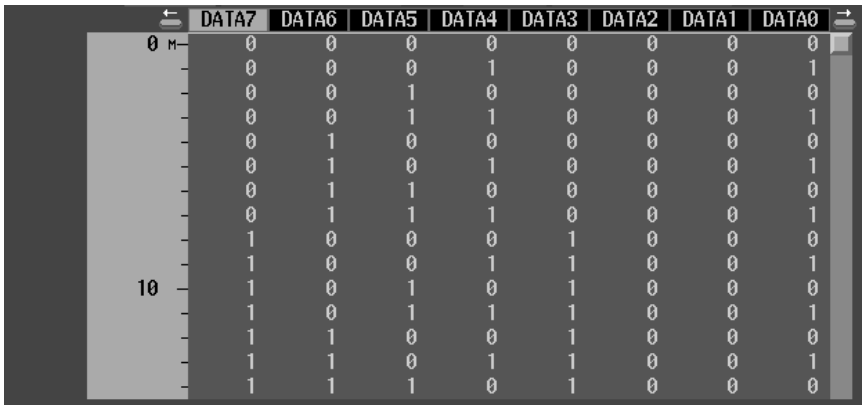


Figure 2-15: Table display format

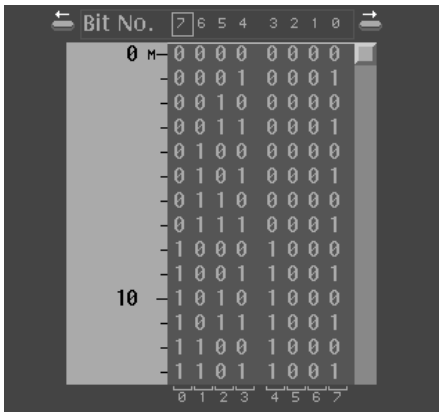


Figure 2-16: Binary display format

The Timing display format shows the waveform patterns for the data graphically with the time axis in the horizontal direction. The TIming display shows the data so that data transitions and the relationships between bits can be easily grasped.

The Table display format shows the data for each clock as numeric values for each group.

The Binary display format shows the data bit states for each clock as 0 or 1. This is the basic display for digital signals, and is an appropriate format for handling data in bit units. If no groups are defined, data can only be displayed in binary format.

Note that the values of the grouped data are displayed with the bits that form those groups converted to hexadecimal in the Timing and Table display formats. Displaying multiple bits grouped in this manner is called bus display. The binary display format displays each bit independently, regardless of the group definitions.

While the same output results whichever display format is selected, these display formats have the following distinguishing features. Use these different formats according to your needs.

Edit Operations

The DG2030 user interface eliminates problems found in many other graphical signal editors. Most user interfaces that adopt graphical menu items execute editing operations as soon as that operation is selected from a menu. This method has the problem that operation becomes inefficient if the same operation must be repeated many times. Another problem is that the screen area is not large enough to make selections from the editing operations menu items while checking the data being edited on the screen. The DG2030's user interface was designed with these points in mind. The DG2030 pattern data editing functions separates the selection and execution of editing operations.

The different editing operations are selected from the **EDIT → Execute Action** menu. Pressing the front panel **EXECUTE** button executes the selected operation. Editing can be accomplished quickly by using the general purpose knob and the **CURSOR** button to move the cursor and then pressing the **EXECUTE** button. Figure 2-17 shows the procedure used to select the Invert data editing operation and then invert data bits at three locations.

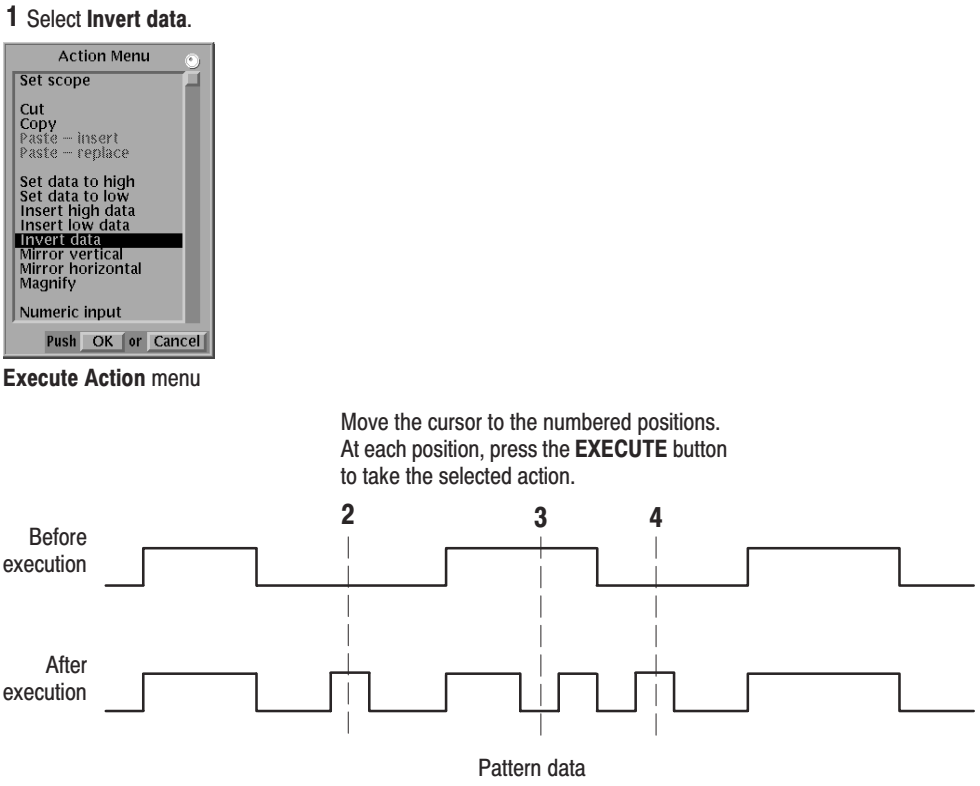


Figure 2-17: Pattern data editing procedure

Area and Point Cursors

When editing pattern data, there are two types of cursors used for indicating the data that will be the object of the edit operation. The type of cursor-used depends on whether a particular point in the data must be indicated, or an area of data must be indicated.

Each type of cursor has a different form. They are called the area cursor and the point cursor. Figure 2-18 shows these cursors.

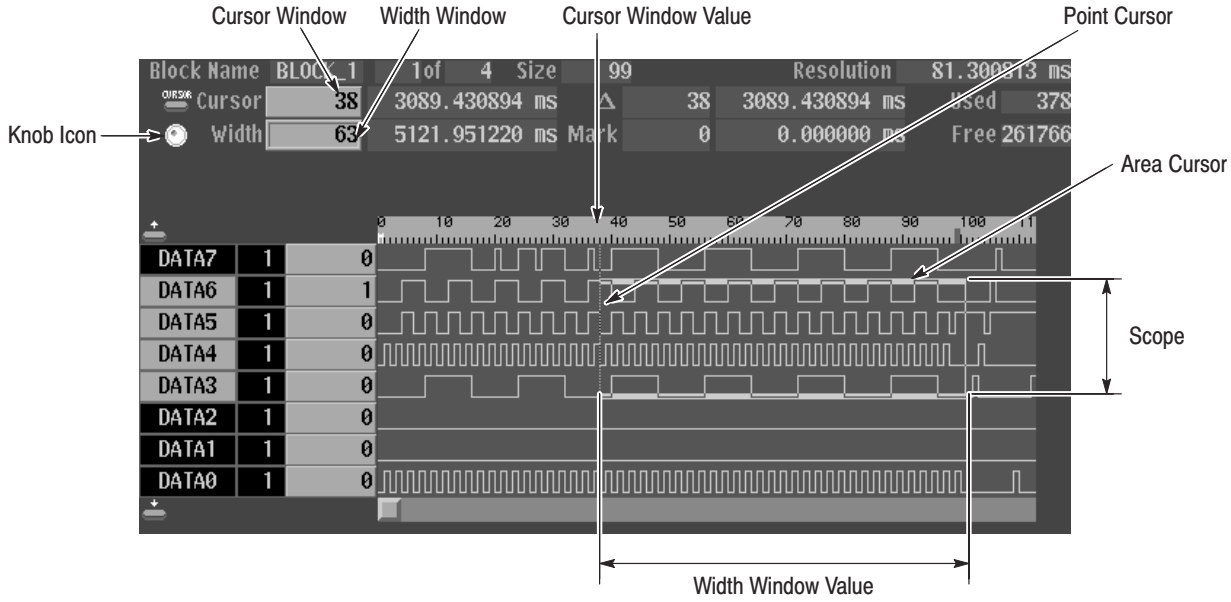


Figure 2-18: Area and Point cursors

The area cursor is used to select a range of signal data, such as during a copy operation. In this operation, the data in the area specified by the area cursor is copied to the edit buffer memory. The paste operation is an example where the point cursor is used. In this operation, data that was previously loaded into the edit buffer memory is copied into pattern memory at the point specified by the point cursor.

The area cursor's area is determined by a combination of an area origin (as defined by a data group and a sample point position), the number of points (which corresponds to the width of the area) and the scope (which corresponds to the height of the area). The origin data group is set with the up and down arrow buttons. The area cursor origin sample point is displayed in the **Cursor** window at the upper left of the screen in the same way as the point cursor is displayed, and can be manipulated in the same way as the point cursor.

The width of the area cursor is displayed in the Width window, and can be set with the general purpose knob or numeric keys when the knob icon has been moved to the Width window using the **CURSOR** button. Use the **EDIT → Execute Action → Set Scope** item to set the area cursor height.

The position of the point cursor is determined by a data group and a sample point. The data group is set with the vertical arrow buttons. The sample point position is displayed in the **Cursor** window at the upper left of the screen. It can be set with the general purpose knob or the numeric keys when the knob icon has been moved to the Cursor window with the front panel **CURSOR** button.

Text Input

Text input is required to enter the names for data groups, data blocks, floppy disk files, and other items. When such input is required, the instrument brings up the dialog box shown in Figure 2-19.

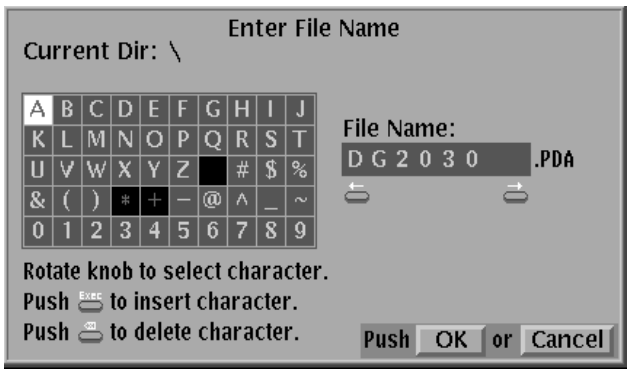


Figure 2-19: Text input menu

The text input menu displays a default string for the item. Use the side menu **Clear String** button to erase this default string. Use the arrow buttons or the general purpose knob to move the reverse-video cursor to the desired character in the letter/digit matrix, and pressing the **EXECUTE** button. Incorrect input can be erased with the delete key. The position where the character is inserted is indicated with an underscore. Use the left and right arrow buttons to change the position of the underscore. When all required characters have all been selected, press the **OK** button on the side menu to complete the operation. To cancel text input and return to the previous menu, press **Cancel** on the side menu.

Popup Message Box

The instrument displays a message box that prompts you to confirm operations that would be difficult to recover. Figure 2-20 shows the file deletion confirmation message box. Press the side menu **OK** button to execute the operation displayed in the box. Press **Cancel** to cancel the operation and return to the state prior to selecting the current menu.

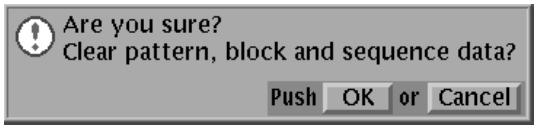
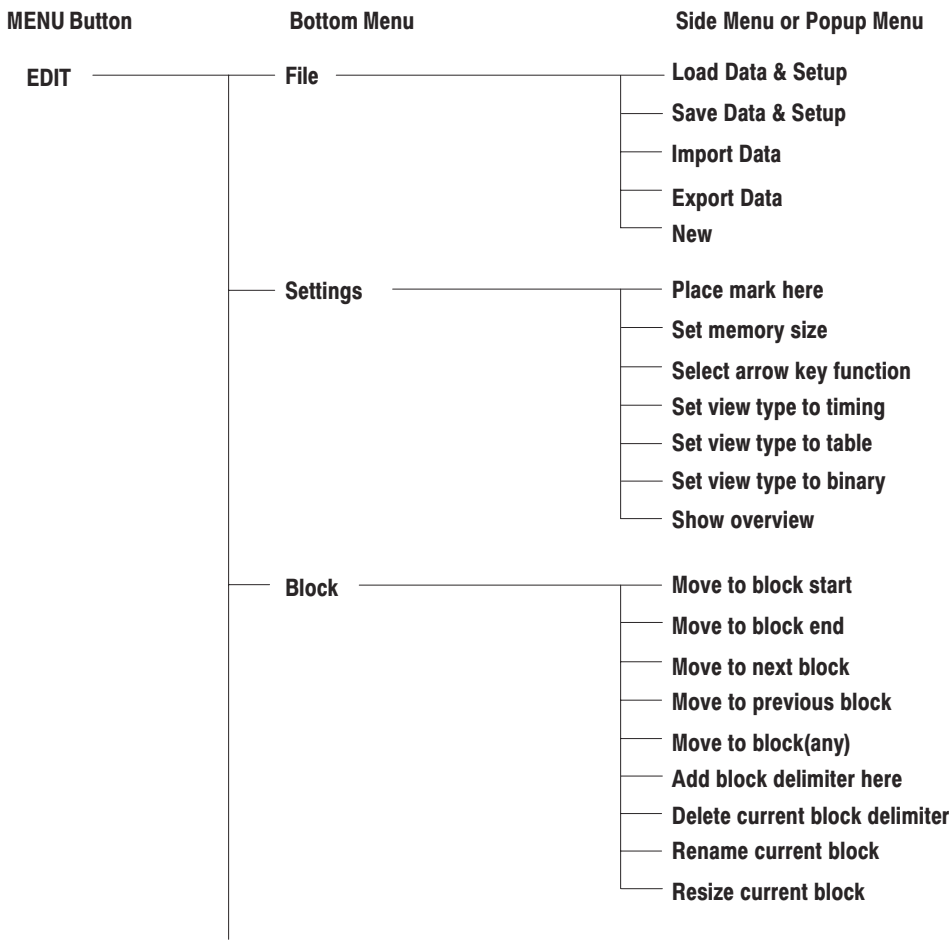


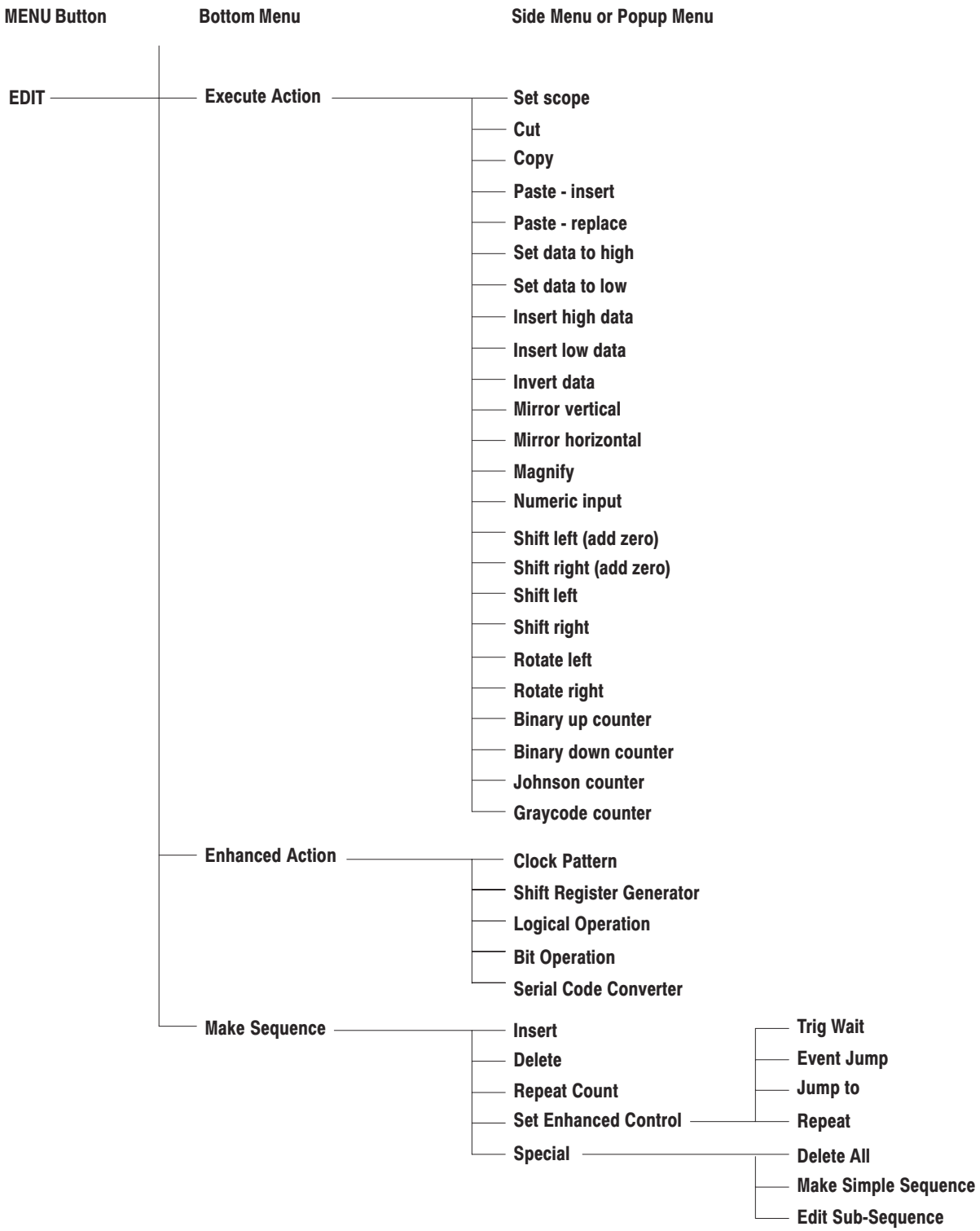
Figure 2-20: Popup message box

Menu Trees

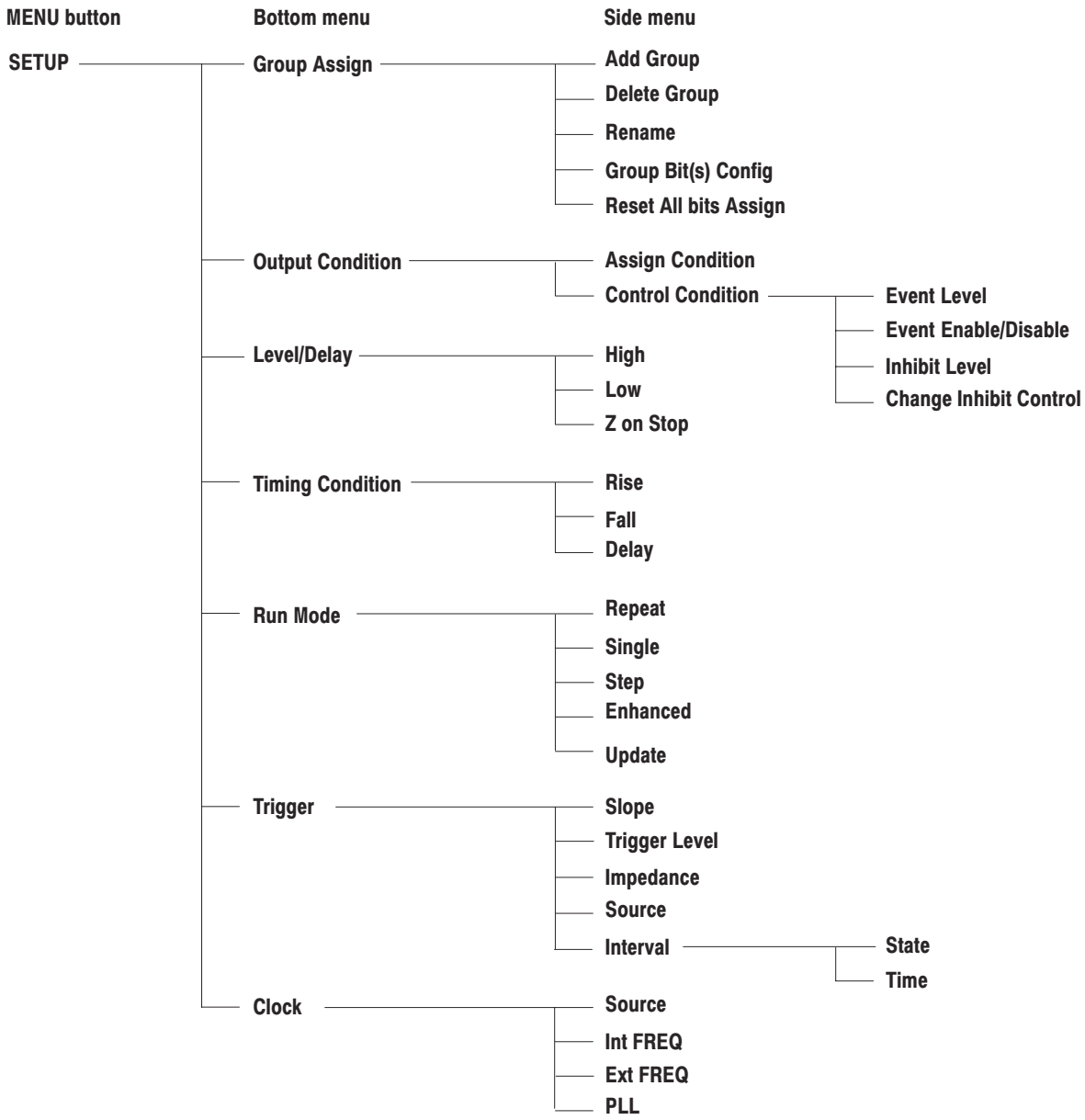
Menu trees are shown for the **EDIT**, **SETUP**, and **UTILITY** menus.

Edit Menu Tree

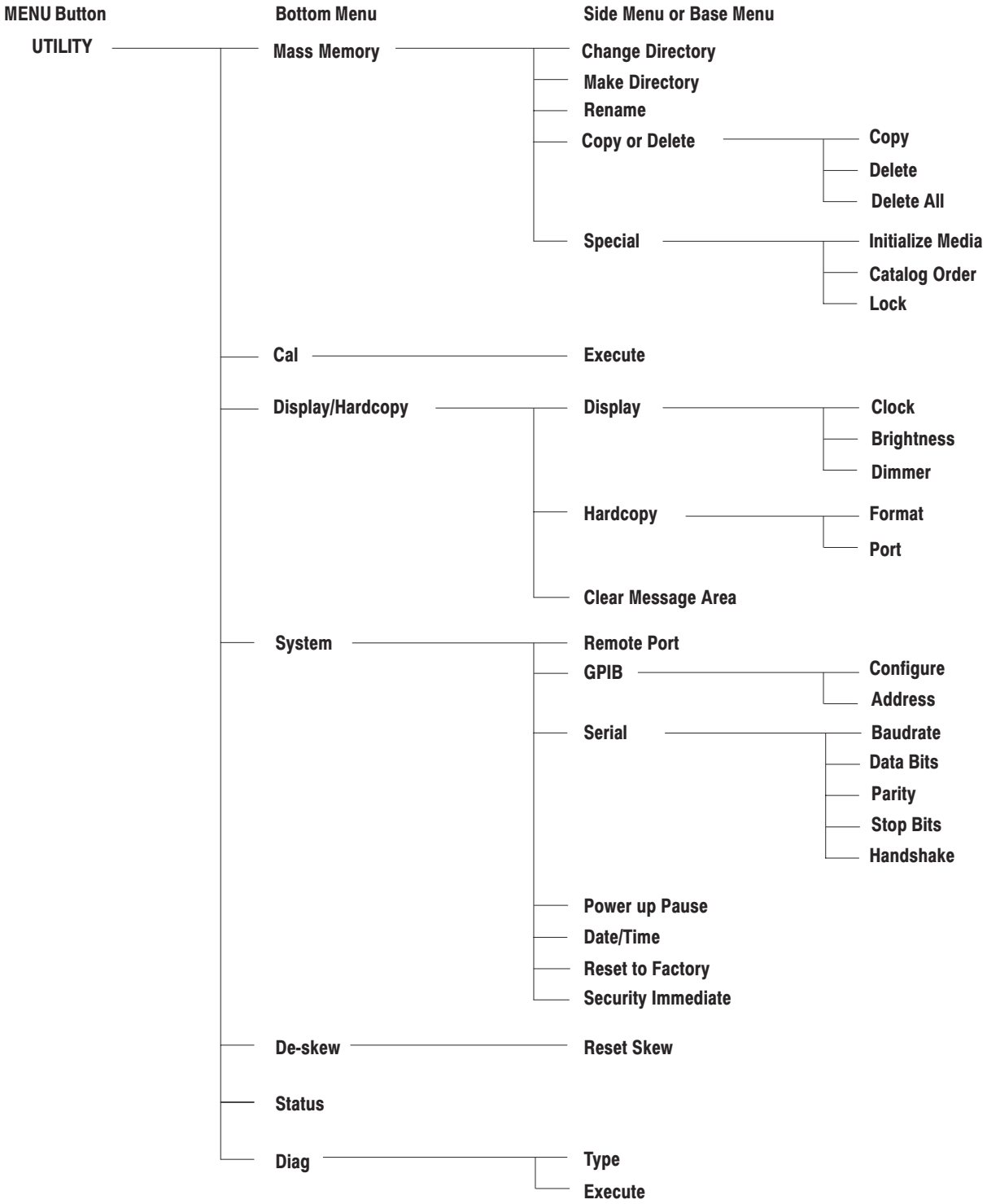




Setup Menu Tree



Utility Menu Tree



Operating Examples

This chapter describes DG2030 operating procedures from pattern signal creation through output by presenting simple examples. Following these procedures is a good way for new users to get an overview of the instrument's operation. This section presents the following four sample procedures.

1. Creating a Pattern and Storing into a File
2. Loading and Editing a Pattern Stored in a File
3. Setting up Signal Output
4. Creating a Sequence

Refer to the menu descriptions in the *Reference* section for detailed explanations of the menus and functions used in these procedures.

***NOTE**. These examples do not cover all the features and functions of the DG2030. They are intended only to introduce the operations required to execute the instrument's basic functions.*

Required Equipment

The following equipment is required for examples 1 through 4.

- An IBM-formatted floppy disk (2HD, 1.44 MB)
- A digital storage oscilloscope (A Tektronix TDS-Series oscilloscope or equivalent)
- Two BNC cables

Before Starting Examples

Be sure that the DG2030 is properly installed. Refer to *Installation* on page 1-6.

Turn the DG2030 on. Refer to *Power On* on page 1-9 for details on turning the DG2030 on.

You do not need to connect the oscilloscope until Example 3.

Operating Procedure Sequences

Each operating procedure is presented in table format in order starting with step 1, and progresses through the end of the procedure. Tables such as the one shown below list the steps for each procedure task. For these steps, press the buttons in the order shown in the table, from left to right in each row, from top to bottom of the table. If a number is shown in the front panel button column, enter that value using the keypad. For popup menus, use the general purpose knob to select items from the menu list. Operations such as operation 6 (below) do not involve pressing the buttons shown in the row above, but rather are descriptions of operations to be performed. Figure 2-21 shows the buttons used and the menu layout.

Menu button	Bottom button	Popup menu	Side button	Front Panel button
Operation 1	Operation 2	Operation 3	Operation 4	Operation 5
Operation 6 (For example, set to xx with general purpose knob.)				
			Operation 7	

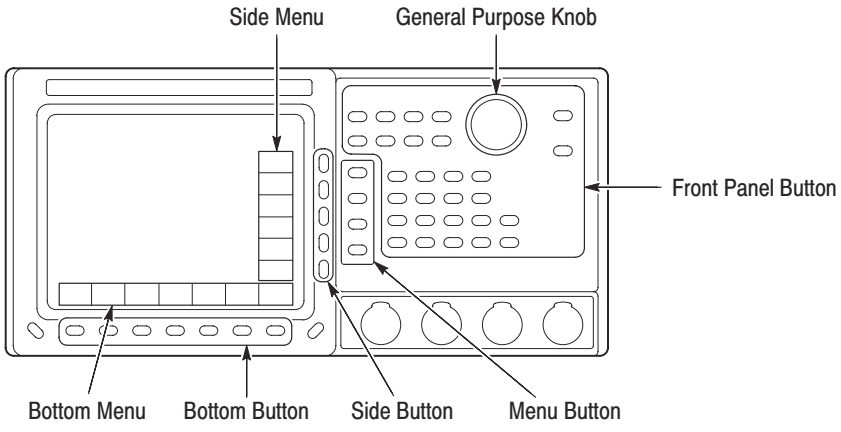


Figure 2-21: Operating buttons

Example 1: Creating a Pattern and Storing into a File

Example 1 creates the output pattern for an 4-bit binary counter and stores that pattern into a floppy disk.

Preparation for Pattern Creation

Before creating new pattern data, initialize the instrument's data and settings.

1. Clear the data group definitions and data memory.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Group Assign		Reset All bits Assign	
			OK	
EDIT	File		New	
			OK	

Environment Setup for Pattern Creation

2. Set the pattern memory length to 1024 points.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Settings	Set memory size	OK	1024 *
				ENTER
			OK	

*** Use the front panel keypad to enter numeric values.**

3. Set the data bit positions and bit widths. Here we will set the height (scope) and width of the data we are going to edit.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Execute Action	Set scope	OK	
		4	OK	
Move the knob icon to the Cursor window in the upper left of the screen by pressing the front panel **CURSOR** button once or twice.				
				0
				ENTER
Move the knob icon to the Width window in the upper left of the screen by pressing the front panel **CURSOR** button once.				
				1024
				ENTER
Press the down arrow button until the area cursor covers DATA0 to DATA3.				

Pattern Creation

4. Create the binary pattern for a value being incremented every 4 clock ticks.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Execute Action	Binary up counter	OK	4
				ENTER
			OK	EXECUTE

This creates the binary pattern shown in Figure 2-22 in DATA0 to DATA3.

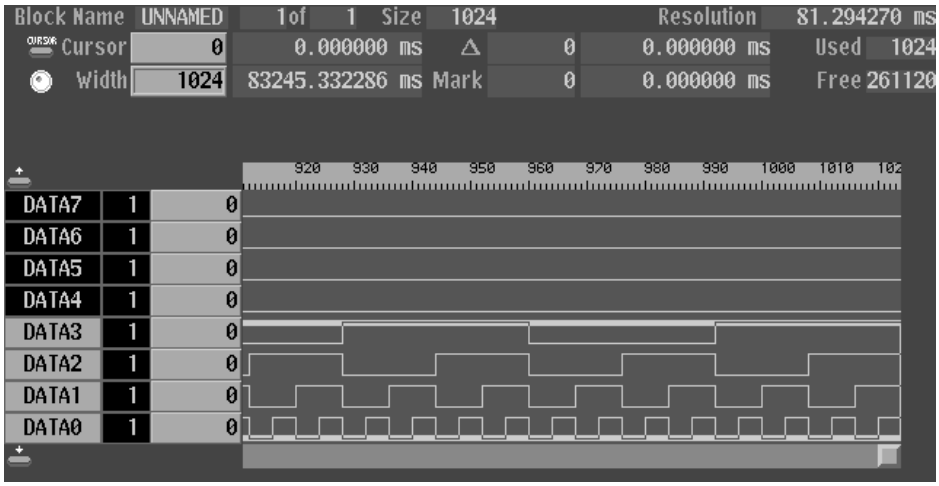


Figure 2-22: Binary pattern creation

Saving the Created Data

5. Save the created data on the floppy disk.

a. Insert a blank IBM-formatted floppy disk in the drive.

b. Name the new file COUNT1.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	File		Save Data & Setup	
			Clear String	
		COUNT1 *	OK	

*** Select each character in the file name using the general-purpose knob and the up and down arrow buttons. Press the EXECUTE button to insert the character in the file name.**

The data in this procedure is saved in the file COUNT1.PDA.

Example 2: Loading and Editing a Pattern Stored in a File

Example 2 loads a file from a floppy disk, and demonstrates pattern editing using that data.

Before loading a file from the floppy disk, initialize the instrument's data and settings. This allows you to see the effect of loading the file you previously saved in example 1.

1. Clear the data group and data definitions.

Menu Button	Bottom Button	Popup Menu	Side Button	Front Panel Button
SETUP	Group Assign		Reset All bits Assign	
			OK	
EDIT	File		New	
			OK	

Reading the File

2. Read in the file created in example 1 from the floppy disk.

a. Insert the floppy disk in the instrument's floppy disk drive.

b. Execute the following actions.

Menu Button	Bottom Button	Popup Menu	Side Button	Front Panel Button
EDIT	File		Load Data & Setup	
Select the file **COUNT1.PDA** from the file list using the general-purpose knob.				
			OK	

This loads the pattern created in example 1.

Selecting Bits to Edit

3. Select DATA4 and DATA5 as the area to be edited.

Menu Button	Bottom Button	Popup Menu	Side Button	Front Panel Button
	Execute Action	Set scope	OK	
		2	OK	
Move the knob icon to the **Cursor** window in the upper left of the screen by pressing the front panel **CURSOR** button once or twice.				
				0
				ENTER
Move the knob icon to the **Width** window in the upper left of the screen by pressing the front panel **CURSOR** button once.				
				1024
				ENTER
Press the up and down arrow buttons until the area cursor covers DATA4 and DATA5.				

Shifting Pattern

4. Do the following steps to shift the bits in DATA4 and DATA5 exactly one sample width to the right.

Menu Button	Bottom Button	Popup Menu	Side Button	Front Panel Button
	Execute Action	Shift right (add zero)	OK	EXECUTE

Inserting a Glitch

5. DO the following steps to insert a glitch with a width of 1 sample in the DATA5 bits.

a. Set DATA5 as the bits that will be the object of the edit.

Menu Button	Bottom Button	Popup Menu	Side Button	Front Panel Button
	Execute Action	Set scope	OK	
		1	OK	
Set the block cursor to cover DATA5 using the up and down arrow buttons.				

b. Set the glitch width to be 1.

Menu Button	Bottom Button	Popup Menu	Side Button	Front Panel Button
Move the knob icon to the **Width** window in the upper left of the screen by pressing the front panel **CURSOR** button once or twice.				
				1
				ENTER

c. Select invert as the edit operation.

Menu Button	Bottom Button	Popup Menu	Side Button	Front Panel Button
	Execute Action	Invert data	OK	

d. Insert two glitches.

Menu Button	Bottom Button	Popup Menu	Side Button	Front Panel Button
Move the knob icon to the **Cursor** window in the upper left of the screen by pressing the front panel **CURSOR** button once.				
				32
				ENTER
				EXECUTE
				96
				ENTER
				EXECUTE

This step inserted glitches at the points for cursor positions 32 and 96.

Figure 2-23 shows the pattern edited in example 2.

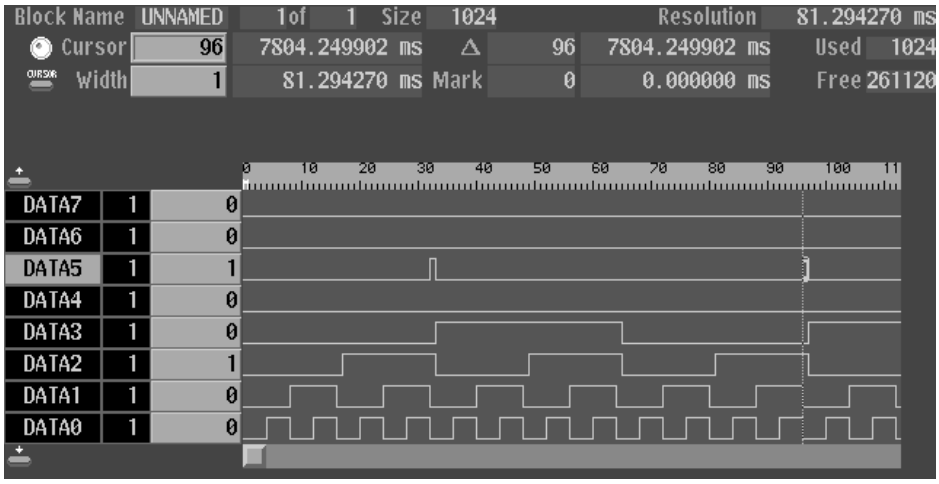


Figure 2-23: Pattern edited in example 2

Saving the Edited Data

6. Save the edited data on the floppy disk.

a. Insert a writable floppy disk in the drive.

b. Name the new file COUNT2.

Menu Button	Bottom Button	Popup Menu	Side Button	Front Panel Button
	File		Save Data & Setup	
			Clear String	
		COUNT2	OK	

The data in this procedure will be saved in the file COUNT2.PDA.

Example 3: Signal Output

Example 3 first groups the data bits from the pattern data created in example 2 and allocates each data bit to output channels. Next, this procedure sets all the settings required for signal output and actually outputs the signals.

Grouping data bits

1. Assign DATA0 to DATA3 to a group called IC1.

a. Reset all bit allocations.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Group Assign		Reset All bits Assign	
			OK	

b. Set the MSB (most significant bit) and LSB (least significant bit) to D3 and D0, respectively.

Menu button	Bottom button	Popup menu	Side button	Front panel button
		Select 4 DATA3	Group Bit(s) Config	
			MSB (Set D3)	
			LSB (Set D0)	
			OK	

***NOTE**. The MSB setting may change depending on the direction the general purpose knob is turned. If that happens, the MSB setting must be set again.*

c. Attach the name IC1 to the newly created group.

Menu button	Bottom button	Popup menu	Side button	Front panel button
			Rename	
			Clear String	
		IC1	OK	

2. Assign DATA4 to DATA7 to a group called IC2.

a. Set the MSB and LSB.

Menu button	Bottom button	Popup menu	Side button	Front panel button
		Select 0 DATA7	Group Bit(s) Config	
			MSB (Set D7)	
			LSB (Set D4)	
			OK	

***NOTE**. The MSB setting may change depending on the direction the general purpose knob is turned. If that happens, the MSB setting must be set again.*

b. Attach the name IC2 to the group.

Menu button	Bottom button	Popup menu	Side button	Front panel button
			Rename	
			Clear String	
		IC2	OK	

Then you can see a display as shown in 2-24.

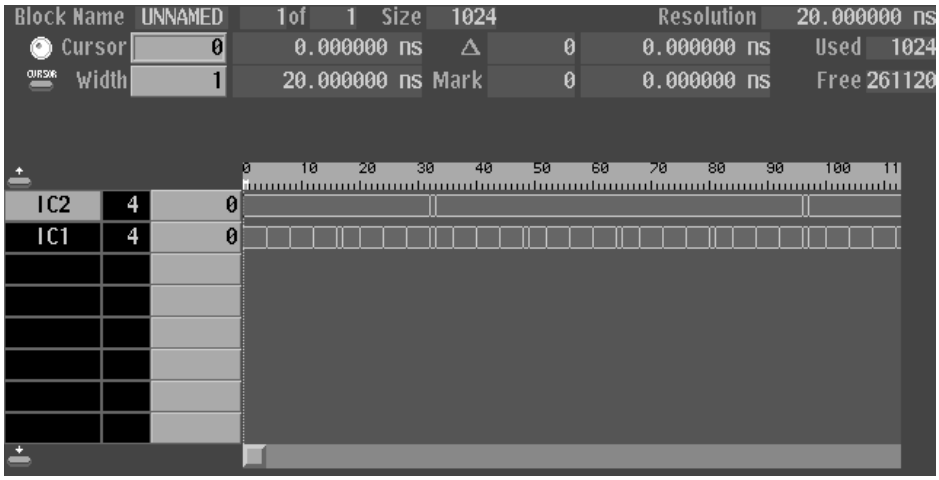


Figure 2-24: Group data

Allocating Data Bits to Output Channels

3. Allocate data bits to output channels **CH0** to **CH7**.

   a. Clear the output channel for channels **CH0** to **CH7**.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Output Condition		Assign	
Press the front panel up and down arrow buttons to select channel **CH0** from the **Output assign list**.				
			Release	
Clear the **CH1** and **CH7** allocations in the same manner.				

   b. Turn off the output impedance control for each channel.

Menu button	Bottom button	Popup menu	Side button	Front panel button
			Control Condition	
Select **CH0** from the list displayed in the screen using the knob on the front panel.				
			Change Inhibit Control	
		Select OFF	OK	

Menu button	Bottom button	Popup menu	Side button	Front panel button
Using the same procedure to turn off the output impedance control for channels **CH1** to **CH7**.				
			OK	
			Go Back	

c. Allocate the IC1 group data to the output channels **CH0** to **CH3**. See Figure 2-25.

Menu button	Bottom button	Popup menu	Side button	Front panel button
			Assign Condition	
Press the front panel up and down arrow buttons to select channel **CH0** from the **Output assign list**.				
Select data **D3 (IC1:3)** from the **Data bits** list using the general purpose knob.				
			Assign	
Allocate **D2** to **D0** to **CH1** to **CH3** using the same procedurel.				
			OK	

d. Allocate the **IC2** group data to the output channels **CH4** to **CH7** in the same way as step c.

***NOTE**. Press the **OK** button when done to activate the allocations. Note that the allocations will not become valid unless the **OK** button is pressed.*

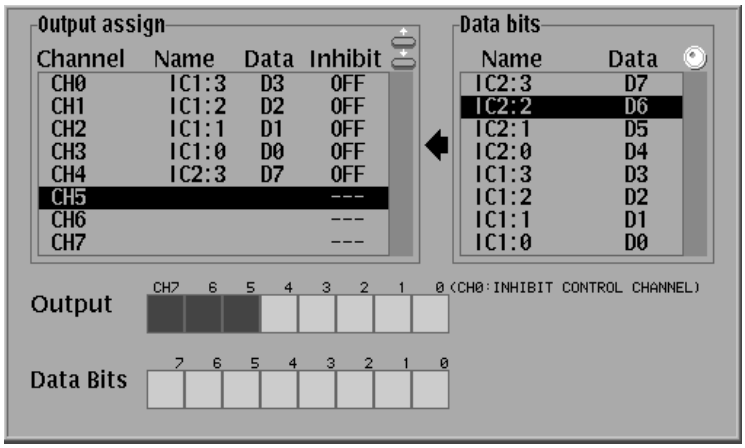


Figure 2-25: Output assign list and channel assignment

To summarize data bits have been allocated, what we have done so far, to the output channels as shown in Figure 2-26.

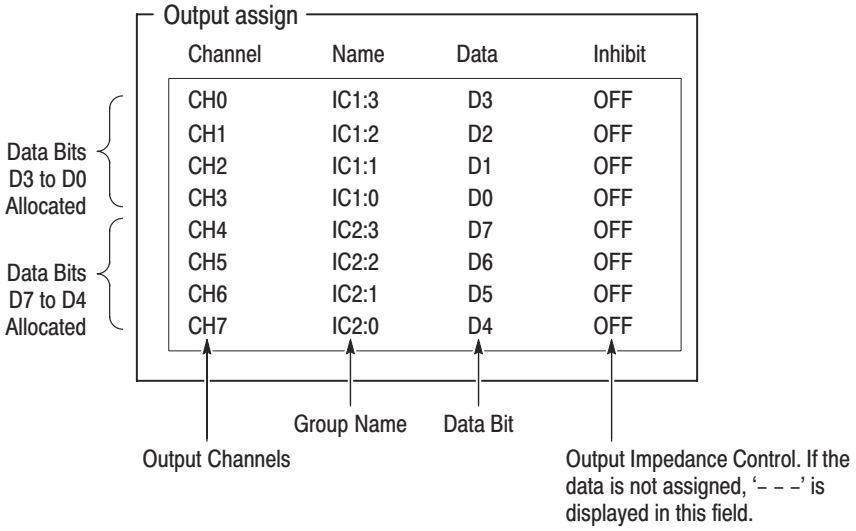


Figure 2-26: Output channel data bit allocation

Setting Sampling Clock Frequency

4. Set the sampling clock frequency to 50 MHz.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Clock		Source (Select Int.)	
			Int FREQ	50
				MHz
			PLL (Select On.)	

Setting Signal Generation Mode

5. Set the signal generation mode to continuous mode.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Run Mode		Repeat	

Setting Output Level

6. Set the channel CH0 to CH7 output levels to 3 V for the high level and –1 V for the low level.

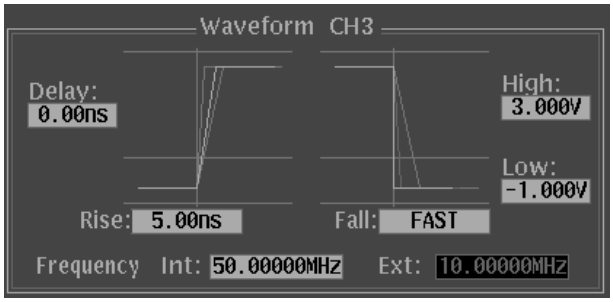
Menu button	Bottom button	Popup menu	Side button	Front panel button
	Level Condition			
Select channel **CH0** by pressing the front panel up and down arrow buttons.				
			High	3
				ENTER
			Low	–1
				ENTER
Set the output levels for channels **CH1** to **CH7** in the same manner.				

Setting Rise/Fall Timing

The rise time and fall time of each output signal can be varied within a certain range.

7. Set the rise time for the output channel CH0 to CH3 to 5 ns and fall time for those channels to FAST. See Figure 2-27.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Timing Condition			
Select channel **CH0** by pressing the front panel up and down arrow buttons.				
			Rise	5
				ENTER
			Fall	0
				ENTER
Set the rise and fall times for channels **CH1** to **CH3** in the same manner.				



Slopes for the rise and fall periods can be set within the ranges indicated by the non-highlighted lines. As a slope, FAST or a value from the range can be selected.

Figure 2-27: Rise /fall time settings

Setting Delay Timing

The delay time for each channel can be set.

8. Set the delays for the output channels **CH4** to **CH7** to 10 ns.

Menu button	Bottom button	Popup menu	Side button	Front panel button
Select channel CH4 by pressing the front panel up and down arrow buttons.				
			Delay	10
				ENTER
Set the delays for channels **CH5** to **CH7** in the same manner.				

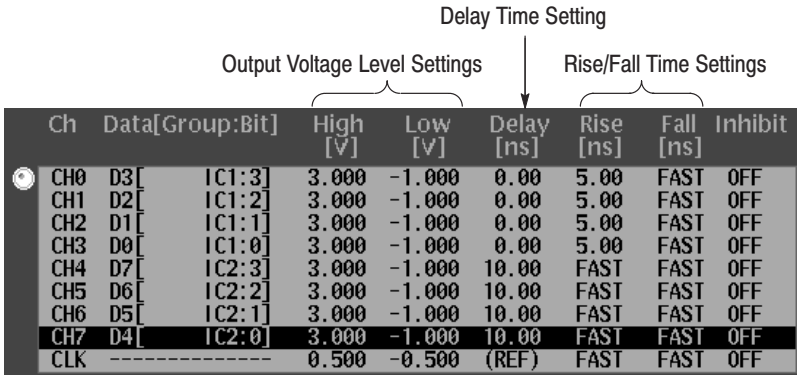


Figure 2-28: Output parameter settings

Signal Output

This step actually outputs the signals and confirms those signals with an oscilloscope.

9. Connect the outputs to the oscilloscope.

Connect the **CH0** and **CH1** on the front panel to the oscilloscope channels CH1 and CH2. This requires two BNC to BNC cables as shown in Figure 2-29.

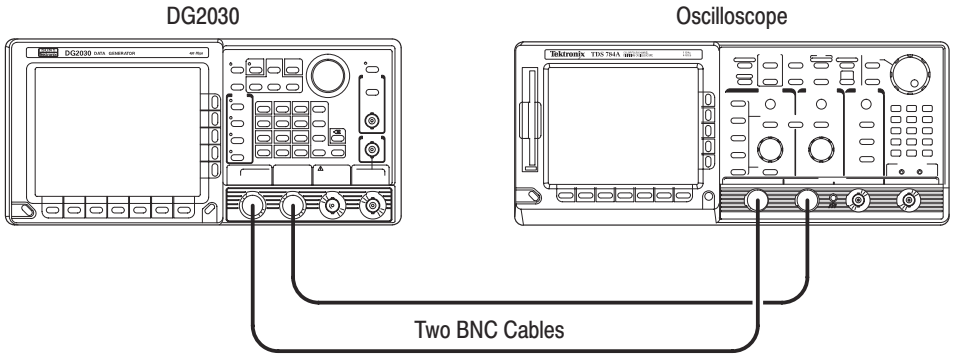


Figure 2-29: DG2030 and oscilloscope connection

10. Press the **START/STOP** button on the front panel.

11. Set up the oscilloscope appropriately and observe the pattern signals on the oscilloscope screen.

Saving State of the Settings

12. Save the state of the settings on the floppy disk.

a. Insert an IBM-formatted floppy disk in the drive.

b. Name the new file COUNT3.

Menu button	Bottom button	Popup menu	Side button	Front panel button
EDIT	File		Save Data & Setup	
			Clear String	
		COUNT3	OK	

The data in this procedures will be saved in the file COUNT3.PDA.

Example 4: Creating a Sequence

Example 4 creates four 128-bit blocks and assigns the blocks to sequences, as shown in Figure 2-30.

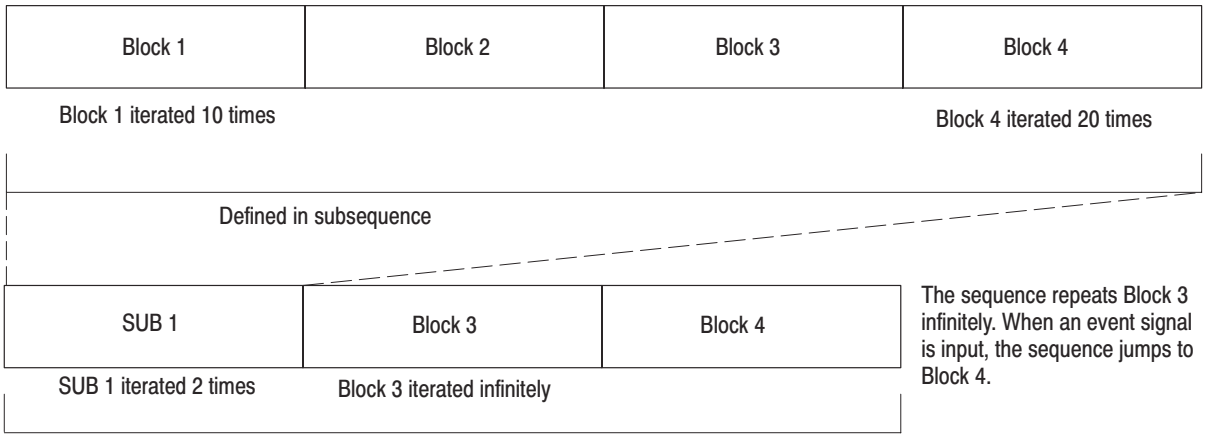


Figure 2-30: Example 4 block sequence

First, create the following data patterns for the blocks.

- Block 1: Binary up-counter pattern
- Block 2: Data pattern consisting of all zeros
- Block 3: Binary down-counter pattern
- Block 4: Data pattern consisting of all ones

Preparing to Create Data

1. Clear the data group definitions and pattern data.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Group Assign		Reset All bits Assign	
			OK	
EDIT	File		New	
			OK	

2. Set the length of pattern memory (the number of samples) to 512 points.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Settings	Set memory size	OK	512
				ENTER
			OK	

3. Set the block cursor position and width. This procedure sets a scope of 8 (DATA0 to DATA7) and a width of 128 samples.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Execute Action	Set scope	OK	
		8	OK	
Move the knob icon to the **Width** window in the upper left of the screen using the front panel **CURSOR** button.				
				128
				ENTER

Creating 4 Blocks

4. Divide the data between block 1 (point 0 to 127) and block 2 (point 128 to 511). Use BK2 as the name for block 2.

Menu button	Bottom button	Popup menu	Side button	Front panel button
Move the knob icon to the **Cursor** window in the upper left of the screen by pressing the front panel **CURSOR** button once or twice.				
				128
				ENTER
	Block	Add block delimiter here	OK	
			Clear String	
		BK2	OK	

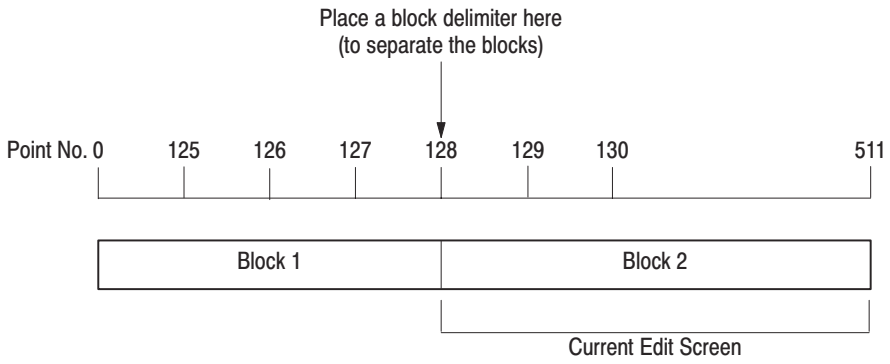


Figure 2-31: Block separation

5. Divide the data from point 128 to point 255 between block 2 (128 to 255) and block 3 (256 to 511). Use BK3 as the name for block 3. Confirm that the knob icon appears in the **Cursor** window in the upper left of the screen. If the icon is not in that window, move it there with the front panel **CURSOR** button.

Menu button	Bottom button	Popup menu	Side button	Front panel button
				256
				ENTER
	Block	Add block delimiter here	OK	
			Clear String	
		BK3	OK	

6. Divide the data from point 256 to point 383 between block 3 (256 to 383) and block 4 (384 to 511). Use BK4 as the name for block 3. Confirm that the knob icon appears in the **Cursor** window in the upper left of the screen. If the icon is not in that window, move it there with the front panel **CURSOR** button.

Menu button	Bottom button	Popup menu	Side button	Front panel button
				384
				ENTER
	Block	Add block delimiter here	OK	
			Clear String	
		BK4	OK	

7. Change the name for block 1 to BK1. Confirm that the knob icon appears in the **Cursor** window in the upper left of the screen. If the icon is not in that window, move it there with the front panel **CURSOR** button.

Menu button	Bottom button	Popup menu	Side button	Front panel button
				0
				ENTER
	Block	Rename current block	OK	
			Clear String	
		BK1	OK	

Creating Block 1 Data

8. Create a binary up-counter data in block 1. First make sure that the value of the Cursor window in the upper left of the screen is 0. Set that value to 0 if it is not already 0. Then perform the following operations.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Execute Action	Binary up counter	OK	1
				ENTER
			OK	EXECUTE

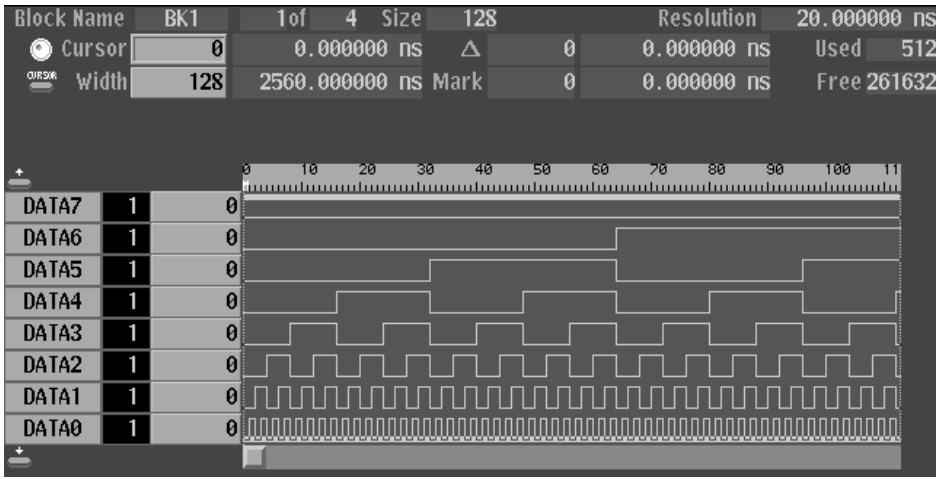


Figure 2-32: Creating a binary up-counter for block BK1

Block 2 Data

The block 2 data is already all zeros. The data can be used as is without editing.

Creating Block 3 Data

9. Create binary down-counter data in block 3. Confirm that the knob icon appears in the **Cursor** window in the upper left of the screen. If the icon is not in that window, move it there with the front panel **CURSOR** button.

Menu button	Bottom button	Popup menu	Side button	Front panel button
				256
				ENTER
	Execute Action	Binary down counter	OK	1
				ENTER
			OK	EXECUTE

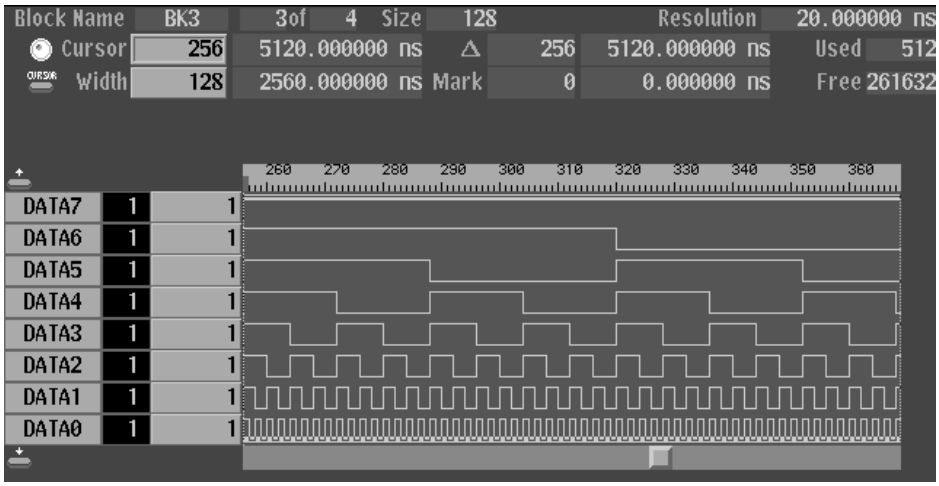


Figure 2-33: Creating a binary down-counter for block BK3

Creating Block 4 Data

10. Create data consisting of all ones in block 4. Confirm that the knob icon appears in the **Cursor** window in the upper left of the screen. If the icon is not in that window, move it there with the front panel **CURSOR** button.

Menu button	Bottom button	Popup menu	Side button	Front panel button
				384
				ENTER
	Execute Action	Set data to High	OK	EXECUTE

Create a Subsequence

In the following example, create one subsequence as shown in Figure 2-34.

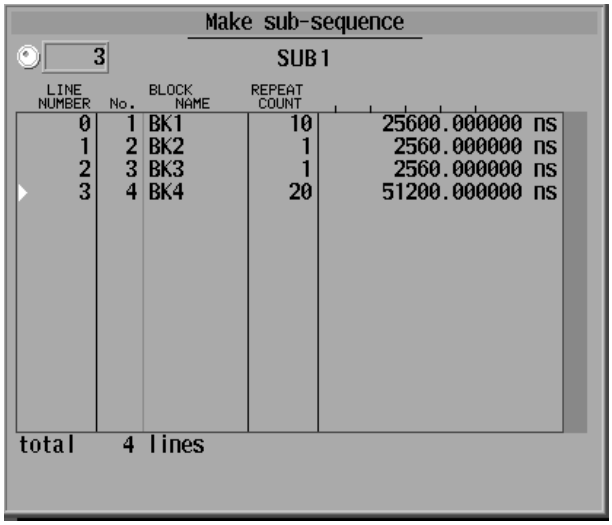


Figure 2-34: Sample subsequence

Following outputs are made when this subsequence is called from the sequence:

- The pattern in BK1 is output 10 times.
- The BK2 pattern is output once.
- The BK3 pattern is output once
- The BK4 pattern is output 20 times.

Next, create a sequence, as shown in Figure 2-35. In the sequence, block or subsequence can be defined in each line. When the sequence is executed, the lines defined with subsequence call those subsequences and execute them.

The BLOCK column of the lines defined with subsequences becomes highlight gray to distinguish from those defined with blocks, as shown in Figure 2-35.

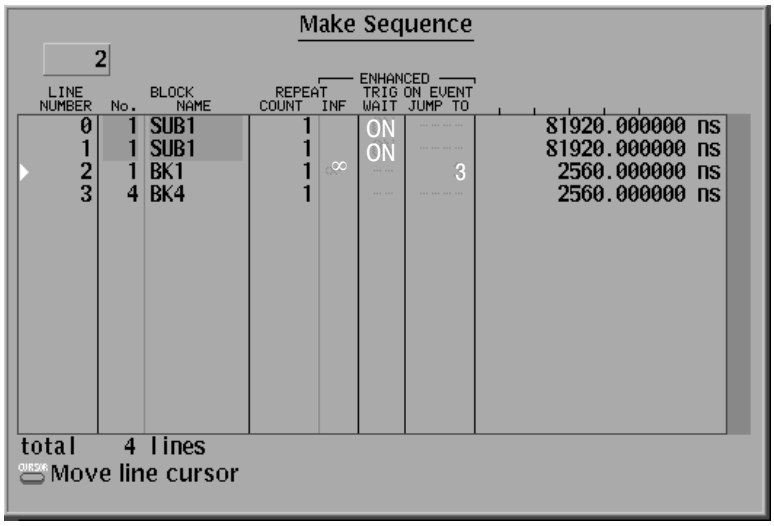


Figure 2-35: Sample sequence

The sequence is performed as follows:

- **Line 0:** Wait trigger event and then call the subsequence.
- **Line 1:** Wait trigger event and then call the subsequence.
- **Line 2:** While waiting event signal, the BK1 pattern is repeatedly output. When the event condition has been satisfied, the process jumps to the line 3.
- **Line 3**: The BK4 pattern is output.

The following two steps create the subsequence.

11. Open the Make Sub-sequence popup menu.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Make Sequence		Special	
			Edit Sub-Sequence	
			New	

12. Create the lines in the popup menu and assign the name SUB1 to the subsequence.

Menu button	Bottom button	Popup menu	Side button	Front panel button
			Insert	
Select the BK1 from the Select block popup menu using the front panel knob.				
			OK	
			Repeat	10
				ENTER
With the front panel down arrow button, advance the line pointer to the next line. See Figure 2-36.				
Using the same procedures as above, insert BK2, BK3 and BK4 into the line 1, 2 and 3, respectively, and set the repeat count to 20 for the BK4.				
			OK	
			Clear String	
		SUB1	OK	
			Go Back	
			Go Back	

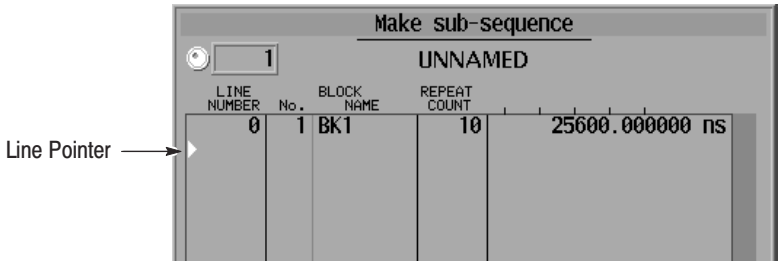


Figure 2-36: Line pointer

Do the following three steps to create the sequence.

13. Create line 0 and line 1 in the sequence.

Menu button	Bottom button	Popup menu	Side button	Front panel button
			Insert	
Select the SUB1 from the Select block and Sub-sequence popup menu using the front panel knob.				
			OK	
			Set Enhanced Control	
			Trig Wait (Set to On)	
			Go Back	
With the front panel down arrow button, advance the line pointer to the next line.				
Using above procedures, insert SUB1 into the line 1 and set the Trig Wait.				

14. Create line 2 and line 3. Note that you can not set the jump address (line number) that has not been created. The jump condition is set in step

Menu button	Bottom button	Popup menu	Side button	Front panel button
			Insert	
Select the BK1 from the Select block and Sub-sequence popup menu using the front panel knob.				
			OK	
			Set Enhanced Control	
			Repeat Count (Set to Infinite)	
			Go Back	
With the front panel down arrow button, advance the line pointer to the next line.				
Using above procedures, insert BK4 into the line 3.				

15. Create line 3, and then terminate editing.

Menu button	Bottom button	Popup menu	Side button	Front panel button
With the front panel up arrow button, move the line pointer back to the line 2.				
			Set Enhanced Control	
			Event Jump (Set to On)	
			Jump to	3
				ENTER
			Go Back	

The following two steps set the trigger and run mode for output.

16. Set the trigger source to external and trigger interval to off.

Menu button	Bottom button	Popup menu	Side button	Front panel button
SETUP	Trigger		Source (Set to Ext)	
			Interval	
			State (Set to Off)	
			Go Back	

17. Set the run mode to Enhanced.

Menu button	Bottom button	Popup menu	Side button	Front panel button
	Run Mode		Enhanced	

Note that when the run mode is set to Enhanced, the displayed settings in the **ENHANCED** columns of the Make Sequence menu become gray. See Figure 2-37.

18. Output the sequence and observe the pattern using an oscilloscope. See Figure 2-29 on page 2-48 for the connection between the DG2030 and the oscilloscope.

Press **START/STOP** button on the front panel to start output. The message *Waiting for Trigger* is displayed soon at upper right part of the screen.

The first two lines in the sequence wait for a trigger event. Press the **FORCE TRIGGER** button on the front panel to generate the trigger event.

The sequence in line 2 outputs the BK1 pattern repeatedly until the event condition is satisfied. Press the **STEP/EVENT** button on the front panel to quit the loop and to advance to sequence line 3.

In Enhanced mode, the entire sequence is repeatedly output. So the message *Waiting for Trigger* is displayed again and again until you press the **START/STOP** button on the front pane.

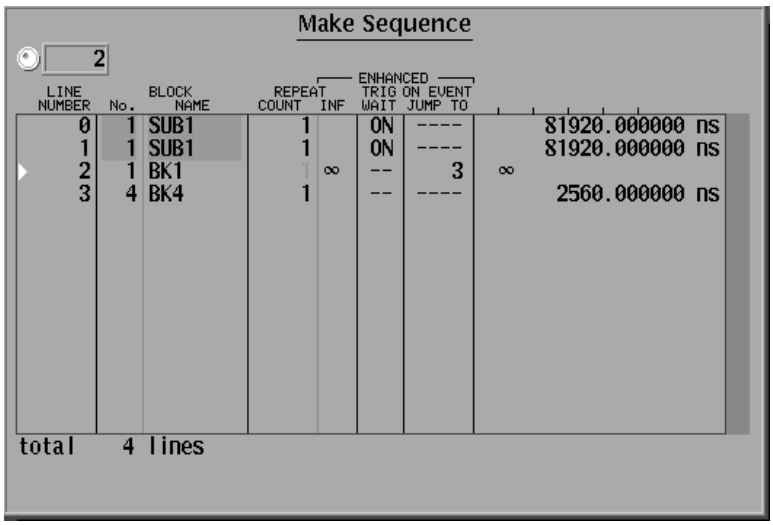


Figure 2-37: Sample sequence

Saving the Example Sequence

19. Exit sequence creation mode and save the data in a file. Name the file SEQ1.

Menu button	Bottom button	Popup menu	Side button	Front panel button
Insert a writable floppy disk into the floppy disk drive.				
	File		Save Data & Setup	
			Clear String	
		SEQ1	OK	

This creates the file called SEQ1.PDA. If a file of the same name already exists a message asking if that file should be overwritten will be displayed. Press **OK** once more if that message is displayed.

Reference

This section provides the following information:

- A detailed description of the Edit, Setup, and Utility menus.
- Procedures for editing pattern data and creating sequences.
- Procedures for defining groups, setting up channels, setting pod voltages, operating modes, and triggers.
- Procedures for setting and saving instrument settings.

***NOTE**. The current firmware version does not provide any functions under the **APPLICATION** menu.*

Operation Outlines

Figure 3-1 and Figure 3-1 show a typical example for operation flow from creating and editing pattern data to outputing it.

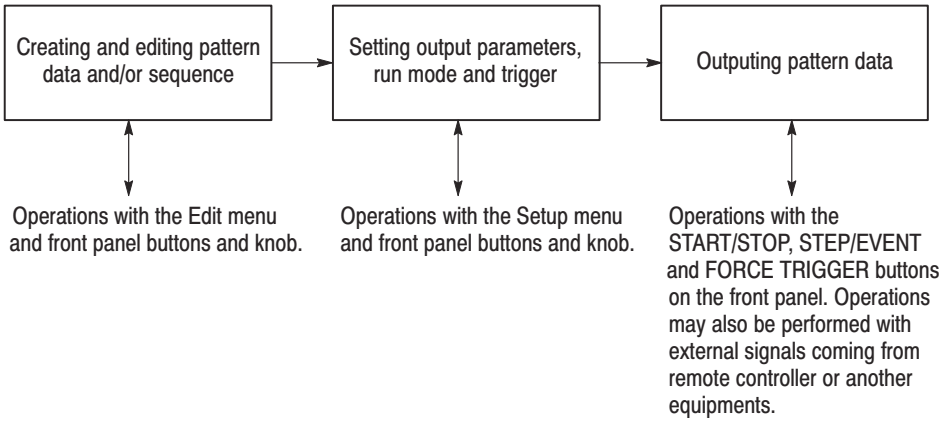


Figure 3-1: Operation flow for pattern data output #1

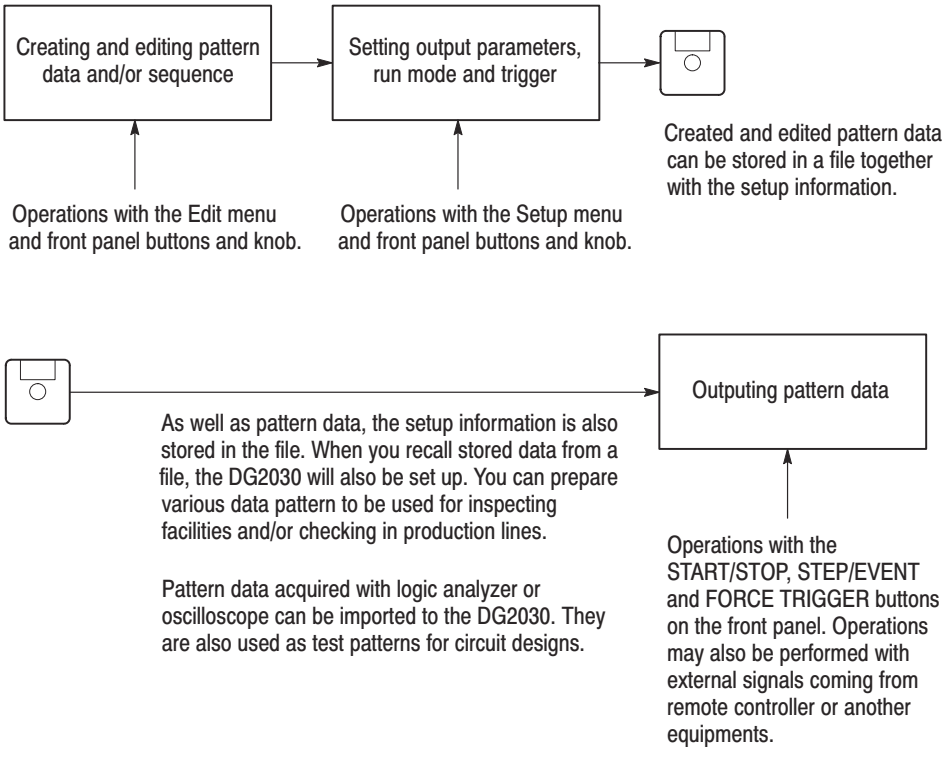


Figure 3-2: Operation flow for pattern data output #2

Creating Pattern Data and Sequences

Data pattern can be created and edited with functions in the EDIT menu.

Pattern Data

Here is a basic operation flow for creating pattern data.

1. Set memory size with **EDIT → Settings → Set memory size**. The default memory size is 1000 word.
2. Specify work area with **EDIT → Execute Action → Set scope** and **Width** on the screen.
3. Create a pattern with the functions in **EDIT → Execute Action**.
4. Repeat step 2 and 3 until the pattern data that you want is created.

Sequence

Here is a basic operation flow for creating a sequence.

1. Create more than one block (pattern data delimited by block delimiter) on the pattern memory as following steps:
   a. Create the pattern data using the procedures described in *Pattern Data* above.
   b. Change the block name with **EDIT → Block → Rename current block**.
   c. Move the cursor to the data point next to the end of the pattern data by changing the value in the **Cursor** on the screen.
   d. Mark the block delimiter with **EDIT → Block → Add block delimiter here**. This creates a new block. The block must have a unique name, which you can enter at this time.
   e. Create the next block pattern using the procedures described in *Pattern Data* above.
   f. Repeat step c through e until all blocks you need are created.

2. Create a sequence table as follows:

   a. Open the sequence editor with **EDIT → Make Sequence**.

   b. If you need, create sub-sequence(s) with **EDIT → Make Sequence → Special → Edit Sub-Sequence → New**.

   c. Compose the lines by inserting the blocks and/or sub-sequences with **EDIT → Make Sequence → Insert**.

   d. Define the control conditions in each line with **EDIT → Make Sequence → Repeat Count** and/or the functions of **EDIT → Make Sequence → Set Enhanced Control**.

Setups for Output

Once you have created pattern data or sequences, do the following steps to configure the instrument hardware and set the output parameters:

1. Assign data bits (DATA0 to DATA7) to output channels (CH0 to CH7) with **SETUP → Output Condition → Assign Condition**. By default, DATA0 to DATA7 are assigned to CH0 to CH7, respectively.
2. Set the pulse high and low levels with **SETUP → Level Condition**.
3. Set the edge slopes and delay with **SETUP → Timing Condition**.
4. Set the output frequency with **SETUP → Clock**.

Outputs

Output your pattern data using the following steps:

1. Press the **START/STOP** button on the front panel to start signal output.
2. Press the **START/STOP** button again to stop output.

Advanced Control for Sequence

Using the event, trigger and run modes, you can control the pattern data output timing and sequence from an external controller or just pressing the front panel buttons. For advanced control, do the following steps:

1. Set the trigger wait and/or event jump into each line on the sequence with the functions of **EDIT → Make Sequence → Set Enhanced Control**. See *Sequence* described above.
2. Set the trigger parameters with **SETUP → Trigger**.
3. Set the event and/or inhibit parameters with **SETUP → Output Condition → Control Condition**.
4. Set the run mode with **SETUP → Run Mode**.

Edit Menu

The bottom menu for the **EDIT** menu includes the **File**, **Settings**, **Block**, **Execute Action**, **Enhanced Action**, **Make Sequence**, and **Undo** items. Table 3-1 lists the functions of the **EDIT** menu items and the pages where their documentation appears.

Table 3-1: EDIT menu functions

Bottom	Base or side menu	Function	Page
File	Load Data & Setup	Loading pattern data and setup parameters	3-9
	Save Data & Setup	Saving pattern data and setup parameters	3-9
	Import Data	Loading pattern data from mass memory	3-10
	Export Data	Writing pattern data to mass memory	3-16
	New	Initialization for data creation	3-18
Settings	Place mark here	Setting the reference mark	3-19
	Set memory size	Setting the memory size	3-20
	Select arrow key function	Setting the operation of the arrow buttons	3-21
	Set view type to timing	Setting the pattern data display format	3-23
	Set view type to table		
	Set view type to binary		
	Show overview		
Block	Move to block start	Moving the cursor for the block	3-25
	Move to block end		
	Move to next block		
	Move to previous block		
	Move to block(any)		
	Add block delimiter here	Delimiting blocks	3-26
	Delete current block delimiter	Combining blocks	3-27
	Rename current block	Changing a block name	3-28
	Resize current block	Changing the size of a block	3-28

Table 3-1: EDIT menu functions (Cont.)

Bottom	Base or side menu	Function	Page
Execute Action	Set scope	Setting the scope	3-31
	Cut	Deleting pattern data	3-32
	Copy	Copying pattern data	3-32
	Paste - insert	Pasting (inserting) pattern data	3-32
	Paste - replace	Pasting (replacing) pattern data	3-33
	Set data to high	Setting pattern data to high	3-33
	Set data to low	Setting pattern data to low	3-33
	Insert high data	Inserting high data	3-34
	Insert low data	Inserting low data	3-34
	Invert data	Inverting data	3-34
	Mirror vertical	Swapping pattern data in the vertical direction	3-35
	Mirror horizontal	Swapping pattern data in the horizontal direction	3-36
	Magnify	Magnifying pattern data	3-36
	Numeric input	Inputting pattern data numerically	3-36
	Shift left (add zero) or Shift right (add zero)	Shifting pattern data left or right by inserting zeros	3-38
	Shift left or Shift right	Shifting pattern data left or right	3-38
	Shift up (add zero) or Shift down (add zero)	Shifting pattern data up or down by inserting zeros	3-38
	Shift up or Shift down	Shifting pattern data left or right	3-38
	Rotate left or Rotate right	Rotating pattern data left or right	3-40
	Rotate left or Rotate right	Rotating pattern data up or down	
	Binary up counter	Creating standard pattern data	3-41
	Binary down counter		
	Johnson counter		
	Graycode counter		
Enhanced Action	Clock Pattern	Clock pattern generation	3-43
	Shift Register Generator	Pseudorandom pulse generation	3-45
	Logical Operation	Logical operations between pattern data items	3-48
	Bit Operation	Moving or copying pattern data	3-50
	Serial Code Converter	Serial code data conversion	3-51

Table 3-1: EDIT menu functions (Cont.)

Bottom	Base or side menu	Function	Page
Make Sequence	Insert	Sequence definition	3-56
	Delete		3-57
	Repeat Count		3-57
	Set Enhanced Control		3-57
	Special		3-58
Undo		Cancel the latest operation and restore the previous setting	3-61

Edit Display

This section describes the **EDIT** menu screen shown in Figure 3-3. Table 3-2 provides a description and page number references.

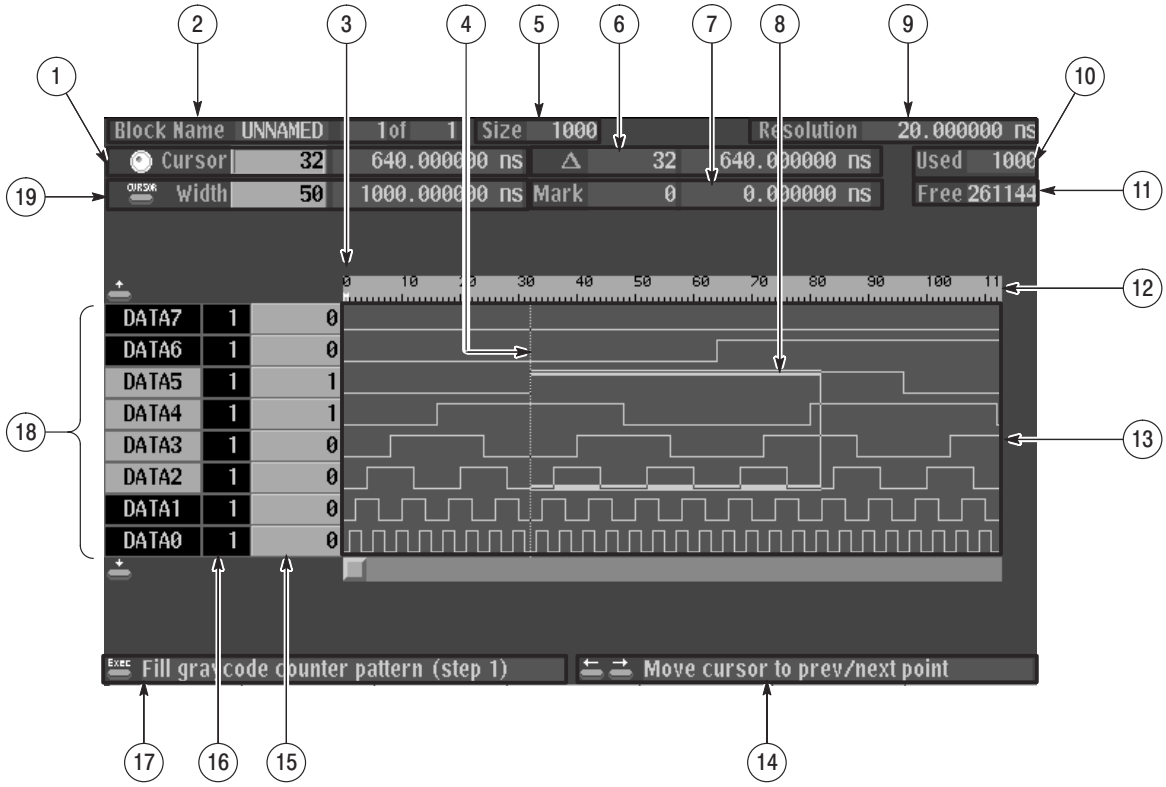


Figure 3-3: EDIT menu (timing display)

Table 3-2: Edit menu display

Screen Reference	Function	Page
1	Displays the point position of the cursor pointer, and the time from the start of the data. When the knob icon is displayed at the left edge, the cursor can be moved with the general purpose knob.	
2	The block name. Also the adjacent area is used to display the position of the current block with respect to the total number of blocks. There is only one block in the example shown in the figure, and currently the block UNNAMED is being displayed.	
3	Displays a **M** to mark the position of the reference.	3-19
4	The cursor	
5	Displays the memory size of the block at the cursor position.	3-20
6	Displays the difference between the reference mark (3) and the cursor as a number of points and also as a time.	
7	Displays the position of the reference mark (3) as a point value and as a time.	
8	The area cursor. The area enclosed by this cursor is the object of the execute action editing operations. The area is set by the **Set scope** (vertical) in the **Execute Action** menu and **Width** (horizontal) items.	
9	Displays the time per point.	
10	Displays the total memory size for all blocks.	
11	Displays the size of the remaining available memory.	
12	A scale which shows point positions.	
13	Display area for the pattern data.	
14	Describes the current action of the arrow buttons.	3-21
15	Displays the value of the data at the cursor position (4).	
16	Displays the number of bits in the data bit group.	
17	Describes the function of the front panel **EXECUTE** button. Pressing the **EXECUTE** button executes the editing function for the indicated cursor position or area.	3-29
18	Indicates the data bits or the data bit groups. Data bits that are set up to be the object of editing operations are displayed at a higher intensity (bright).	
19	Displays the width of the area cursor as a number of points and as a time.	

File Menu

The File menu saves and loads data between the instrument's internal memory and mass memory (floppy disks). When the **File** bottom menu item is selected, a side menu with **Load Data & Setup**, **Save Data & Setup**, **Import**, **Export**, and **New** items is displayed.

Load Data & Setup

Reads format pattern data, block, group, sequence and setup data into the instrument's internal memory from mass memory (floppy disk).

The DG2030 can read data created and stored from the DG2020. The DG2030 will use the pattern data in the lower 8 bits. Also, the DG2030 can read DG2020 setup information except for those settings that are not common to both platforms.

Sub menu

Item	Function
Change Directory	Changes the current directory.

Operation. Load the pattern data and setup parameters.

Bottom button	Popup menu	Side button
Insert a floppy disk in the floppy disk drive.		
File		Load Data & Setup
	Select the file to be loaded.	OK

Save Data & Setup

Stores the pattern data, block, group, sequence and setup data from the instrument's internal memory to mass memory (floppy disk) in DG2030 format.

Sub Menu

Item	Function
Clear String	Deletes the current displayed string.
Change Directory	Changes the current directory.

Operation. Save the pattern data and setup parameters

Bottom button	Popup menu	Side button
Insert a write-enabled floppy disk in the floppy disk drive.		
File		Save Data & Setup
	Enter the file name for the data to be saved.	OK

Import

Loads pattern data from mass memory (floppy disk) into pattern memory. The DG2030 can read the following data formats:

- Tektronix TDS series waveform data (file extension: .WFM)
- Tektronix TLS series group data (file extension: .GRP)
- Tektronix AWG2000 series waveform data (file extension: .WFM)
- Tektronix DG2020 and DG2030 waveform data (file extension: .PDA)
- CSV format data (file extension: .CSV). A procedure for formatting data in a CSV format is on page 3-14.

Popup menu parameter settings are used to specify the read-in method.

Operation. Import pattern data from mass memory.

Bottom button	Popup menu	Side button
Insert the floppy disk in the drive.		
File		Import Data
	Select the file to be read in.	OK
	Change the parameters as required.	OK

Popup Menu. Figure 3-4 shows the data read-in configuration window. The parameters that appear in this window differ depending on the data format being read in.

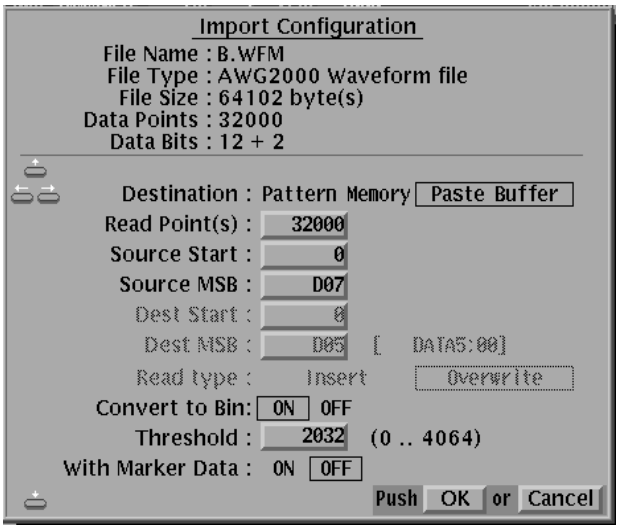


Figure 3-4: Import Configuration Menu (File format: AWG2000 series waveform file)

Table 3-3 describes the input parameters.

Table 3-3: Import parameters

Parameter	Function
Destination	Sets the place where the read-in data is to be written. Either Pattern memory or the Paste buffer can be selected. If data is read into the paste buffer, data can be pasted to the data bit specified by the Paste item in the Execute Action menu.
Read Point(s)	Sets the number of data points to be read. Data in excess of the specified memory size cannot be read in.
Source Start	Specifies the starting position from which the data is read in from the file.
Source MSB	Specifies the position of the MSB from which data in the file will be read.
Dest Start	Specifies the position which data is read in when pattern memory is the destination.
Dest MSB	Specifies the position of the MSB to which data will be written when pattern memory is the destination.
Read type	Sets the data read-in method when pattern memory is the destination. Either Insert or Overwrite can be selected.
Convert to Bin	When this setting is set to ON, the waveform is compared to a threshold level and the data is converted to binary. RP binary data from the Tektronix TDS and TLS series products are read in as RI data. The data cannot be converted to binary data if it is left in the RP state.

Table 3-3: Import parameters (Cont.)

Parameter	Function
Threshold	Sets the threshold level used to convert read-in data to binary when the Convert to Bin parameter is set to ON.
With Marker Data	Sets whether or not marker data is read, in addition to waveform data, for Tektronix AWG2000 series waveform file format data.

Figures 3-5 and 3-6 show the data write operations in terms of point positions and data bit positions when pattern memory is the write destination.

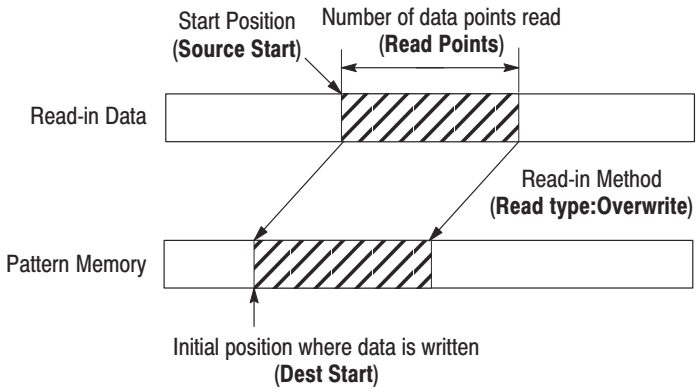


Figure 3-5: Data write in terms of point positions

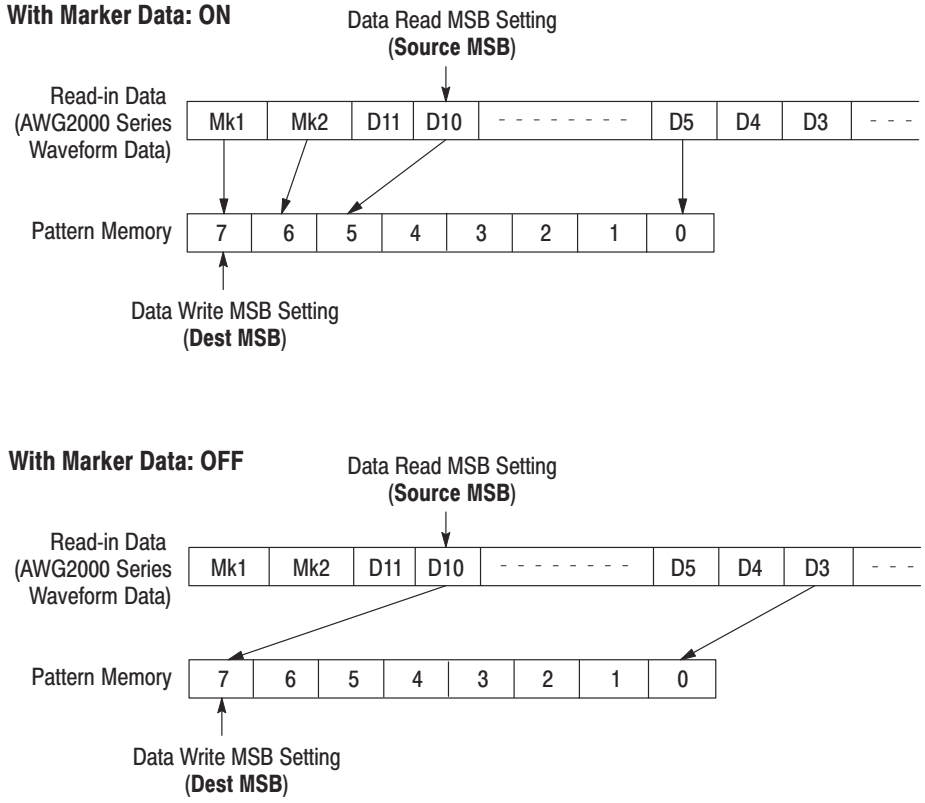


Figure 3-6: Data write in terms of data bit positions

CSV Data Format

The DG2030 can import vector data from the built-in floppy drive using a simple ASCII Comma Separated Variable (CSV) format. This section defines how the data is formatted for importing into the DG2030. The CSV format is defined as follows:

<1DB0><Comma><1DB1><Comma>.....<1DBx><CR>	! The number of bits defines (x) defines the width of the pattern
<2DB0><Comma><2DB1><Comma>.....<2DBx><CR>	! Second word
... ...	
<yDB0><Comma><yDB1><Comma>.....<yDBx><CR>	! The number of lines (y) defines the depth of the pattern

When formatting data in the CSV format, note the following:

- Each data byte is defined by the ASCII character: zero <0>, ASCII 48 or one <1>, ASCII 49
- Each data byte is separated by the ASCII character: comma <,> (ASCII 44), space (ASCII 32), or TAB (ASCII 9)
- Each line is terminated with the ASCII character: carriage return <CR>, ASCII 13
- The number of bits in a line defines the word width. For example, if the first line consists of pattern: 1,0,1,1 then the word width is 4 bits wide
- The number of lines in the file defines the number of words in the pattern. For example, 10 lines defines 10 data words.
- The DG2030 CSV format file is a DOS compatible file formatted as defined above with a .CSV file extension.

CSV Format Example. To export a 8-bit pattern that is 3 words long, create the following data, as an example, and save it using filename: PATTERN.CSV. This can be created using a spreadsheet program, a text editor, or a custom filter program to convert data from one format to another.

1,0,1,0,1,0,0,1<CR>
1,0,0,0,1,1,0,1<CR>
0,0,1,0,1,0,1,1<CR>

***NOTE**. Bit pattern data must have at least 90 words. Above pattern data can not be read into the DG2030. Note that this is a simple example.*

Once the data words have been imported, parameters including clock rate, output levels and inter-channel timing need to be set since the CSV format does not transfer this information. After all operating parameters have been set, the entire pattern can be stored on a floppy for non-volatile storage. The entire pattern will fit on one floppy since the DG2030 uses an instrument specific binary format that is more compact than ASCII format.

Importing Large Data Files. It may be possible to create a large CSV file. Depending on what kind of operation is currently performed, the DG2030 may not allocate the internal work space for creating CSV format data larger than 32768 words. An extreme example is a 8-bit wide word pattern that has 262144 (256 k) words. In this example, the export file would be over 4 megabytes long. For the data to fit to work space and onto a floppy disk capacity, the pattern must be segmented into 32 k (32768 words) blocks and saved to separate floppy disks. To import the data do the following:

1. Insert the floppy with the first 32 k words into the drive.
2. Select **File → Import Data** and select a file to be imported.
3. Press the **OK** button. The Import Configuration popup menu appears. This menu allows you to configure how the data will be imported. In this example, only the **Dest Start** point will be modified.
4. Set the **Dest Start** point to zero for the first floppy disk.
5. Set the **Dest Start** point to 32768 for the second floppy disk.
6. Set the **Dest Start** point to 65536 for the third floppy disk.
7. Repeat above step as incrementing the **Dest Start** point by 32768 until the data from the last floppy disk is read.

Once the data words have been imported, parameters including clock rate, output levels and inter-channel timing need to be set since the CSV format does not transfer this information. After all operating parameters have been set, the entire pattern can be stored on a floppy for non-volatile storage. The entire pattern will fit on one floppy since the DG2030 uses an instrument specific binary format that is more compact than ASCII format.

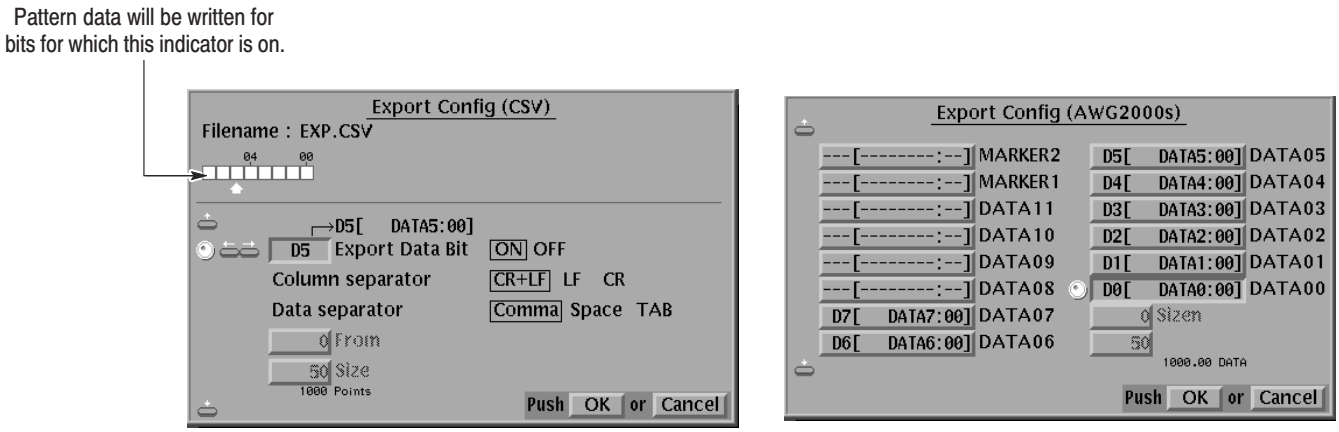
Export Writes pattern data to mass memory (floppy disk). Data is written either as CSV data or as Tektronix AWG2000 Series waveform data. The write method is specified by setting a parameter in a popup menu.

***NOTE**. Icon data and hardware setup data are not saved in the output AWG2000 Series waveform data. When this data is read in to an AWG2000 Series instrument, default setup data will be added. PCs and some other systems may not be able to read this data directly.*

Operation. Write pattern data to mass memory.

Bottom button	Popup menu	Side button
Insert a write-enabled floppy disk in the floppy disk drive.		
File		Export Data
	Select the format of the data to be written (either CSV data or AWG2000s Waveform data).	OK
	Enter the file name for the data to be written.	OK
	Change the parameters as required.	OK

Popup Menu. Figure 3-7 shows the configuration windows for the two formats.



CSV Format **AWG2000 Series Format**

Figure 3-7: The Export Config menu

When CSV format is selected, the instrument displays a menu for selecting which bits should be written to the file, delimiter symbols, and other parameters. Table 3-4 describes the parameter items that are set using this menu.

Table 3-4: Export parameters

Parameter	Function
Export Data Bit	Specifies the data bits to be written to the pattern data. Bits for which this indicator is on are written. Bits can be selected using the general purpose knob, and the on/off state can be changed with the left and right arrow buttons. Consecutive bits can be turned on or off using the 1 and 0 numeric keys.
Column separator	Sets the line separator symbol. The delimiter symbols are usually used as follows: CR+LF: MS-DOS and Windows LF: UNIX CR: Macintosh
Data separator	Sets the inter-bit delimiter. Comma, space, or tab can be selected for this parameter. Comma is the most common setting.
From	This field is valid when Entered is specified for the Region in the sub menu. It specifies the starting position for the data written.
Size	This field is valid when Entered is specified for the Region in the sub menu. It specifies the number of data points written.

When the AWG2000 Series format is selected, a menu that allocates data for a total of 14 bits, **MARKER 1** and **2** and **DATA00** to **DATA11**, is displayed. Use the arrow buttons to select the AWG2000 Series bit and use the general purpose knob to allocate the DG2030 bit. Allocate all bits to be written by repeating this operation.

Sub Menu

Item	Function
Set All Data bits (CSV only)	Sets the data bit write settings for all data bits.
Clear All Data bits (CSV only)	Clears the data bit write settings for all data bits.
Region	When this setting is set to All, the whole data area is written, and when it is set to Entered, the data in the area specified by From and Size is written.

Exporting Large Data. The DG2030 internal memory capacity can not export an 8-bit wide pattern data in CSV format that is larger than 32768 (32 k) words. For the data to write into a floppy disk, the pattern must be segmented into 32 k (32768 words) blocks and saved to separate floppy disks.

To import large data files, do the following:

1. Insert a first floppy disk into the drive.
2. Select the **File → Export Data** to display Export Data Format popup menu.
3. Select **CSV data** and then press **OK** side button.
4. Enter a file name and then press the **OK** button. The Export Config (CSV) popup menu appears. This menu allows you to configure how the data will be exported. In this example, only the **Size** and **From** will be modified.
5. Confirm that the **Region** is set to **Entered**. If not, press the **Region** side button to set to **Entered**.
6. Enter 0 into the **From** and 32768 into the **Size**, and then press **OK** side button.
7. Repeat the procedures from step 2 to step 6 as changing the file name and incrementing **From** point by 32768 until all pattern data are stored into floppy disks. Note that two blocks of 32 K word pattern data in the CSV format can be stored in a 3.5-inch 2HD floppy disk.

New

Initializes all data, including the pattern data, the block divisions, and the sequence data to the default state.

Operation. Initialization for pattern data creation.

Bottom button	Popup menu	Side button
File		New
		OK

Settings Menu

The settings menu sets all the **EDIT** menu internal settings. It supports the following operations.

- Setting the reference mark
- Setting the reference group
- Setting the memory size
- Setting the arrow button operating mode
- Setting the display type (format)

The item to be set is selected from the popup list using the general purpose knob. Figure 3-8 shows the popup menu.

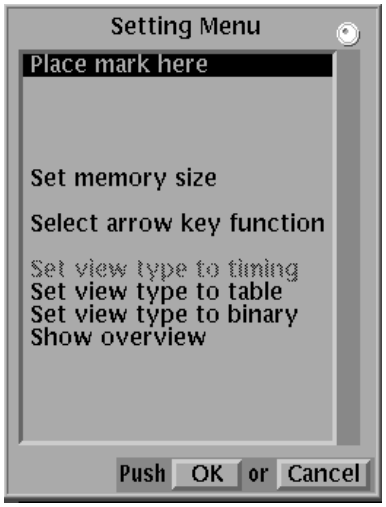


Figure 3-8: Settings popup menu

Place Mark Here

Sets the reference mark at the current cursor position. The reference mark is displayed as an "**M**" on the point scale as shown in Figure 3-9. The interval (**Δ**) between the set reference mark and the current cursor position is displayed as a point difference and as a time difference.

The reference mark only specifies the origin of the delta display. It does not affect the pattern data definition itself.

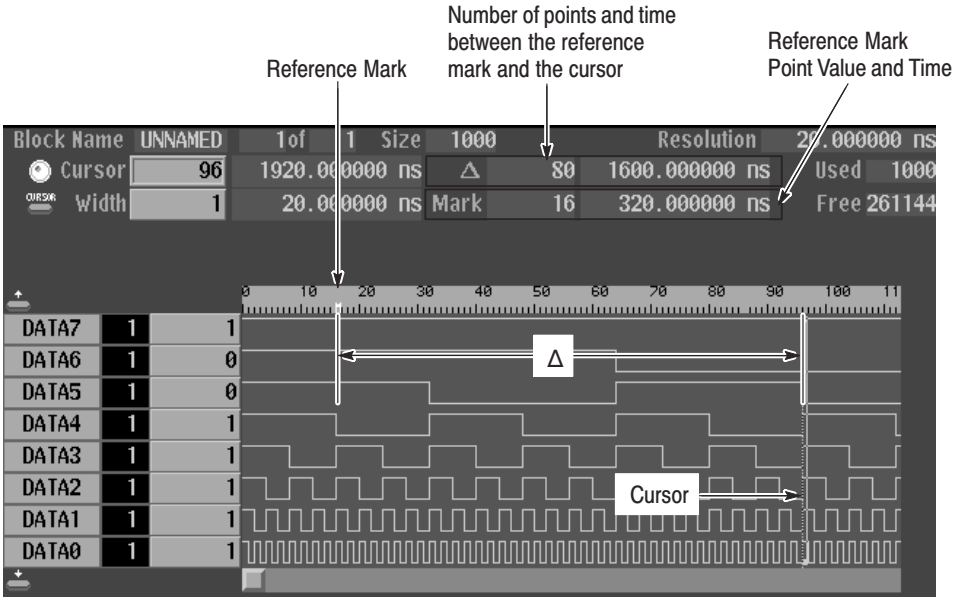


Figure 3-9: Reference mark "M" display

Operation. Set the reference mark

Bottom button	Popup menu	Side button
Move the knob icon to the Cursor window in the upper left of the screen using the up and down arrow buttons.		
Set the cursor to the reference point using the general purpose knob or the numeric keys.		
Settings	Place mark here	OK

Select Memory Size

Sets the pattern data memory size. The size can be set to a value in the range from 90 words to 262144 words. In some cases the memory size setting is changed by operations that change the block length. Items that exceed the memory size due to editing operations are either ignored or discarded.

Operation. Set the memory size

Bottom button	Popup menu	Side button
Settings	Set memory size	OK
	Set the number of points.	OK

Select Arrow Key Function

Defines the actions of the arrow buttons. The term arrow button, refers to the left and right arrow buttons for timing display, and the up and down arrow buttons for table and binary display. Arrow button actions include those associated with cursor movement and those associated with editing operations. Also note that the arrow button action is sometimes changed automatically by the **Execute Action** menu functions described on page 3-29. Figure 3-10 shows an action display within the timing display

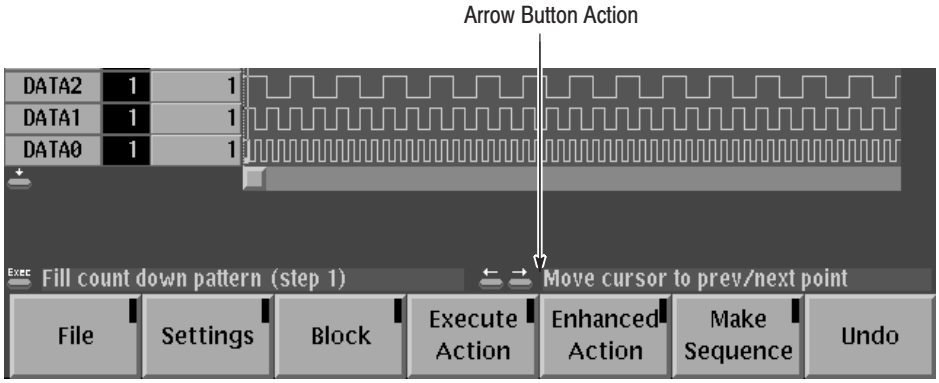


Figure 3-10: Arrow button action display (timing display)

Operation. Set the arrow button action

Bottom button	Popup menu	Side button
Settings	Select arrow key function	OK
	Select the arrow button action.	OK

Popup Menu. Use the general purpose knob to select one of the following actions from the displayed popup menu. Items that currently cannot be used are dimmed as shown in Figure 3-11.

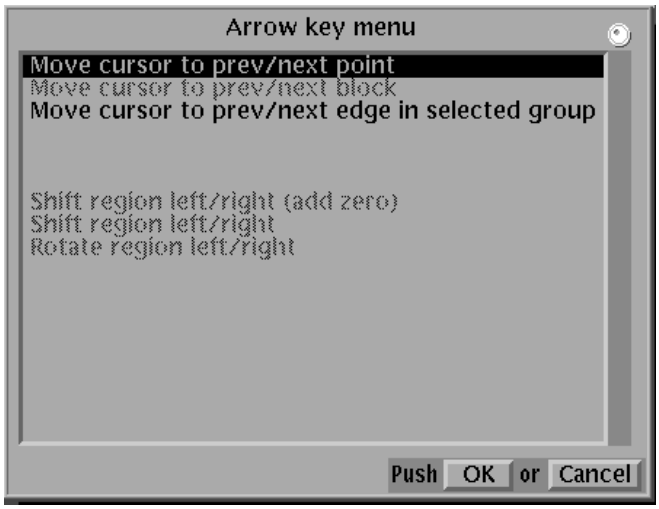


Figure 3-11: The Arrow button menu

Table 3-5: Arrow button functions

Arrow button functionality	Selection item	Description
Cursor movement	Move cursor to prev/next index	Moves the cursor to the immediately preceding or immediately following data point.
	Move cursor to prev/next block	Moves the cursor to the start of the block immediately preceding or immediately following the block where the cursor is currently located.
	Move cursor to prev/next edge in selected group	Moves the cursor to the next place in the currently selected group where the data value changes. This function cannot be used if multiple groups are selected.
Cursor movement associated with editing operations	Shift region left/right (add zero) (Timing display only) Shift region up/down (add zero) (Table and binary display only)	The data in the edit area is shifted left (or up) or right (or down) one point at a time. See the descriptions of the Execute Action menu for the Shift region left/right (add zero) and Shift region up/down (add zero) items.
	Shift region left/right (Timing display only) Shift region up/down (Table and binary display only)	Except for the data point at the end of the editing area, the data in the editing area is shifted left (or up) or right (or down) by 1 point at a time. See the descriptions of the Execute Action menu for the Shift region left/right and Shift region up/down items.
	Rotate region left/right (Timing display only) Rotate region up/down (Table and binary display only)	The data in the editing area is rotated left (or up) or right (or down) by 1 point at a time. See the descriptions of the Execute Action menu for the Rotate region left/right and Rotate region up/down items.

Setting Pattern Data Display Format

Sets the pattern data display format. The display format is selected from the following options.

- Timing display
- Table display
- Binary display
- Overview display

Table 3-6 presents descriptions and examples of the pattern data display formats.

Operation. Set the pattern data display format

Bottom button	Popup menu	Side button
Settings	Select from the following items. Set view type to timing Set view type to table Set view type to binary Show overview	OK

Table 3-6: Pattern data display format

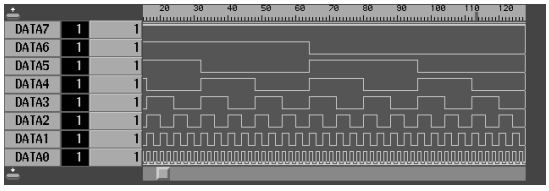
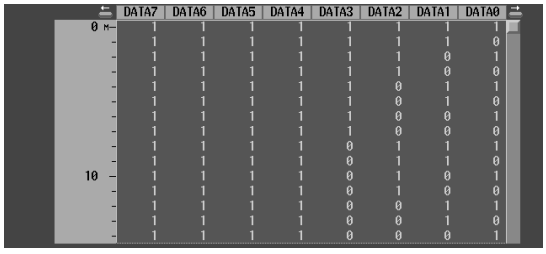
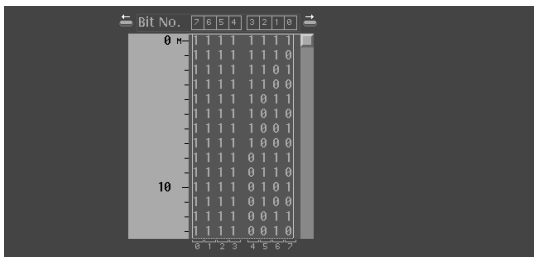
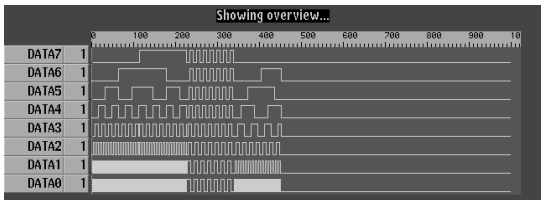
Display format menu item	Description
Set view type to timing	Sets the pattern data display method to the timing format. Hexadecimal editing is possible if groups are defined. 
Set view type to table	Sets the pattern data display method to the table format. Hexadecimal editing is possible if groups are defined. 

Table 3-6: Pattern data display format (Cont.)

Display format menu item	Description
Set view type to binary	Sets the pattern data display method to the binary format. 
Show overview	Displays the whole pattern data on allocated memory area. Editing can not be performed in this mode. 

Block Menu

The block menu is used to define packets of data called blocks and the cursor movement with respect to those blocks. The items to be set are selected from a popup list using the general purpose knob.

Figure 3-12: Block popup menu

Block Relative Cursor Movement. Moves the cursor relative to the current block. Table 3-7 provides a description for each item in the Block popup menu.

Table 3-7: Block relative cursor movement

Select item	Description
Move to block start	Moves the cursor to the start of the block in which the cursor is currently located.
Move to block end	Moves the cursor to the end of the block in which the cursor is currently located.
Move to next block	Moves the cursor to the start of the block following the block in which the cursor is currently located.
Move to previous block	Moves the cursor to the start of the block preceding the block in which the cursor is currently located.
Move to block (any)	Moves the cursor to the start of a block selected from a list of blocks in a popup menu.

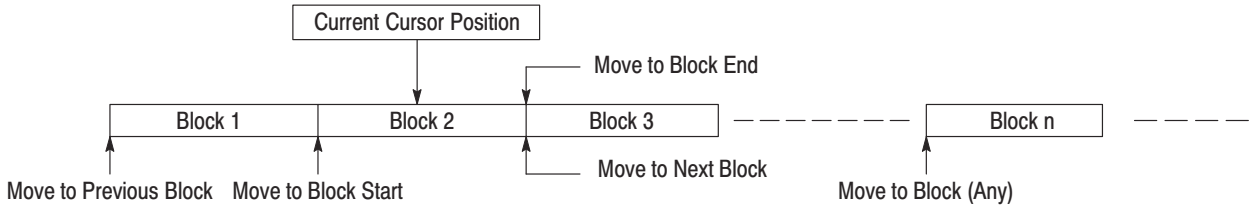


Figure 3-13: Block relative cursor movement

Operation. Block Relative Cursor Movement

Bottom button	Popup menu	Side button
Block	Select from the following items. Move to block start Move to block end Move to next block Move to previous block Move to block (any)	OK
	Select the block to move to. (Move to block (any) only)	OK

Add Block Delimiter Here

Sets a block delimiter at the current cursor position. The delimiter point becomes the starting point of the new block. The block delimiter is marked on the point scale.

***NOTE**. A block delimiter cannot be set at a point that is not at least 90 points away from both the start and the end of the block in which the delimiter is being set.*

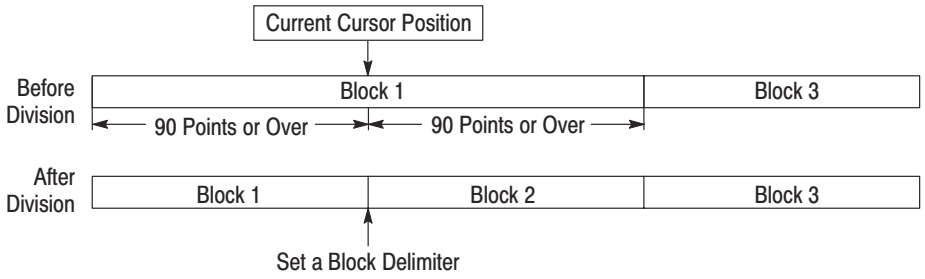


Figure 3-14: Dividing a block

Operation. Divide a block

Bottom button	Popup menu	Side button
Move the knob icon to the Cursor window in the upper left of the screen.		
Move the cursor to the location where the block delimiter is to be placed.		
Block	Select Add block delimiter here.	OK
		Clear String
	Input a block name.	OK

Delete Current Block Delimiter

Deletes the block delimiter between the current block and the preceding block to combine the block with the immediately preceding block.

***NOTE**. To delete the block delimiter, at least one block must exist before the current block.*

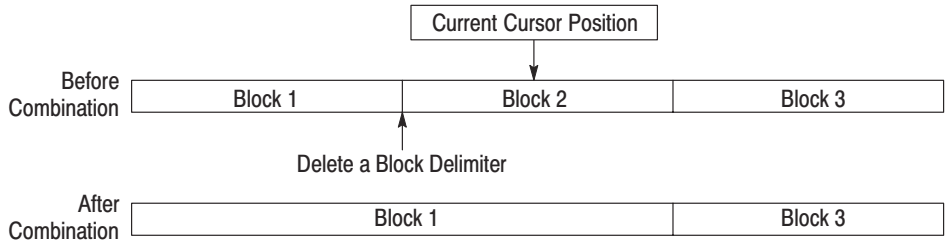


Figure 3-15: Combine blocks

Operation. Combine blocks

Bottom button	Popup menu	Side button
Move the knob icon to the Cursor window in the upper left of the screen.		
Move the cursor to the block whose block delimiter is to be deleted.		
Block	Select Delete current block delimiter.	OK

Rename Current Block

Changes the name of the block at the current cursor position.

Operation. Change a block name

Bottom button	Popup menu	Side button
Move the knob icon to the Cursor window in the upper left of the screen.		
Move the cursor to the block whose name is to be changed.		
Block	Select Rename current block.	OK
		Clear String
	Enter the new block name.	OK

Resize Current Block

Changes the size of the block at the current cursor position. The size of other blocks is not changed; the memory size is changed.

When increasing the size of the current block, only set a size that does not cause the total number of points to exceed the maximum memory size. Zero data corresponding to the increase in size is added at the end of the block.

When decreasing the size of the current block, data is deleted from the end of the block.

Note that the range of allowable block sizes starts at a minimum size of 90 points.

***NOTE**. Changing the block size cannot be reversed with the **Undo** operation.*

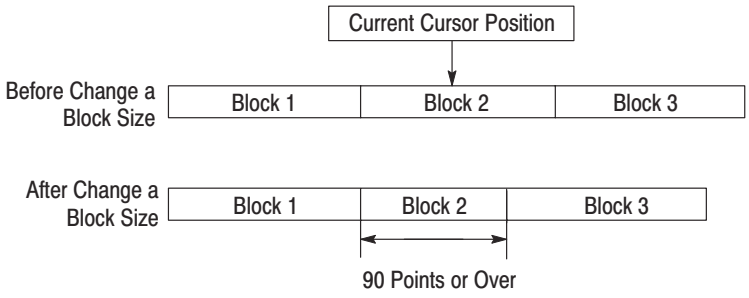


Figure 3-16: Change a block size

Operation. Change a block size

Bottom button	Popup menu	Side button
Move the knob icon to the **Cursor** window in the upper left of the screen.		
Move the cursor to the block whose size is to be changed.		
Block	Select Resize current block.	OK
	Enter the new block size.	OK

Execute Action Menu

The **Execute Action** menu sets up a variety of editing operations. The editing operation is selected from the **Action Menu** (a popup menu, see Figure 3-17) using the general purpose knob. The editing operation is applied to the editing object area when the front panel **EXECUTE** button is pressed.

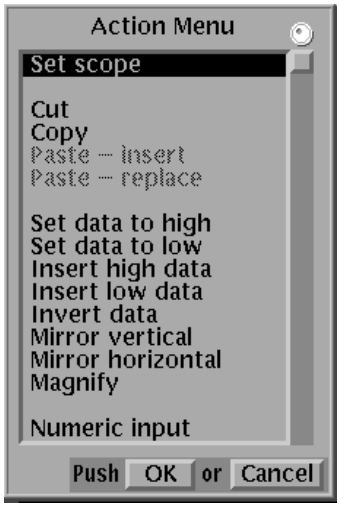


Figure 3-17: Action popup menu

The area of the pattern data that will be the object of the edit may consist of the range enclosed by the area cursor, and may consist of the area following the cursor, depending on the selected editing operation.

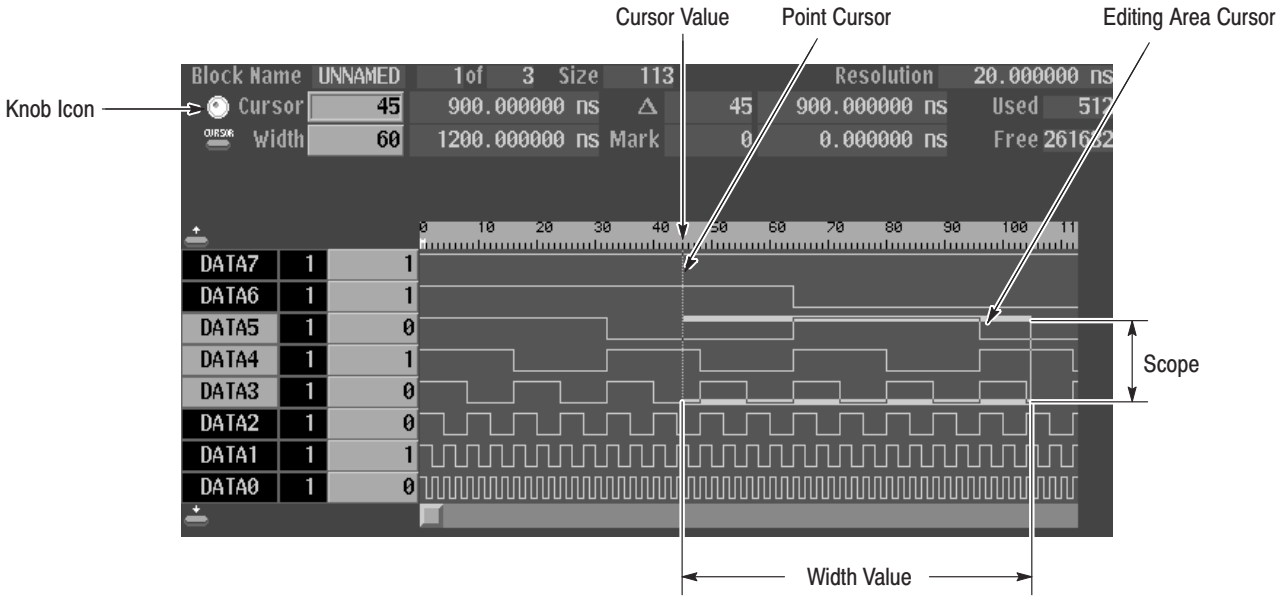


Figure 3-18: Edit area

The location or range that the editing operation applies to is set as follows:

- Point Position Input. The range is determined by the **Width** value. To set the width value, move the knob icon to the **Width** value display by pressing the front panel **CURSOR** button. Then enter the value with the general purpose knob or the numeric keys.

  To set the position move the knob icon next to the **Cursor** position display by pressing the front panel **CURSOR** button. Then enter the value with the general purpose knob or the numeric keys.

- Group/bit Input. The groups or bits to be included in the range are set using the **Execute Action → Set scope** item.

Bottom button	Popup menu	Side button
Execute Action	Select Set scope.	OK
	Determine the scope.	OK

When changing the groups or bits in the editing range, the buttons used will differ depending on the display format. Use the up and down arrow buttons for timing display format, and use the left and right arrow buttons for table and binary display formats.

- Editing Operation. Use the following editing procedure when the area enclosed by the editing area cursor is the object of the editing operation.

Bottom button	Popup menu	Side button
Execute Action	Select the editing operation.	OK
Set the value of the Cursor item at the upper left of the screen.		
Set the value of the Width item at the upper left of the screen.		
Set the groups/bit.		
		EXECUTE

Use the following editing procedure when the area following the cursor is the object of the editing operation.

Bottom button	Popup menu	Side button
Execute Action	Select the editing operation.	OK
Determine the value of the Cursor item at the upper left of the screen.		
Determine the group/bit.		
		EXECUTE

***NOTE**. Pressing the **CLEAR MENU** button clears the selected editing operation.*

Set Scope

Sets the range of groups or bits that will be the object of an editing operation executed by the **EXECUTE** button.

The meaning of a scope element differs depending on the pattern data display format. For the timing and table display format, a element group is a single scope element. For the binary display format a single bit is a single scope element. Therefore in timing and table display, the number of bits that will be edited may change depending on which groups are within the selected range, even though the scope does not change as it is moved.

Operation. Set the scope

Bottom button	Popup menu	Side button
Execute Action	Select Set scope.	OK
	Set the number of scope elements using the knob.	OK

Cut The cursor becomes the area cursor. The data in the editing range is deleted, and data is filled in at the end of memory in an amount equal to the amount of data deleted. The filled data (the tail) is set to 0. Note that the deleted data is inserted in the paste buffer and can be used as paste data.

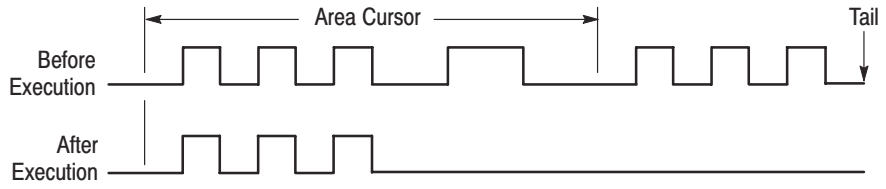


Figure 3-19: Cut

Copy The cursor becomes the area cursor. The data in the editing range is copied to the paste buffer. The pattern data itself is not affected.

Paste-insert Inserts the data in the paste buffer at the current cursor position. The data after the cursor is moved to the rear by the length of the pasted data. After the data is moved, data that exceeds the set memory size is lost.

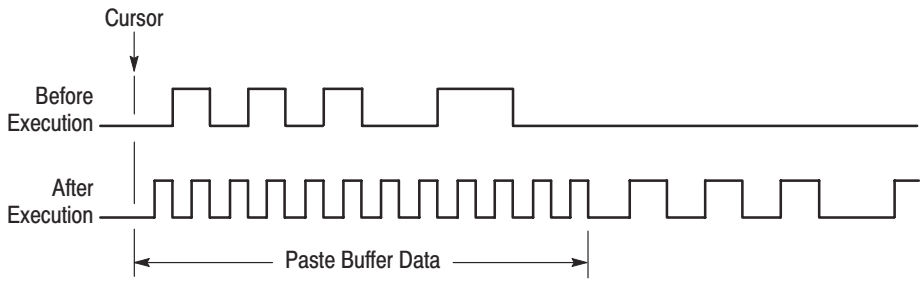


Figure 3-20: Paste – insert

Paste-replace Writes the data in the paste buffer over the data starting at the current cursor position.

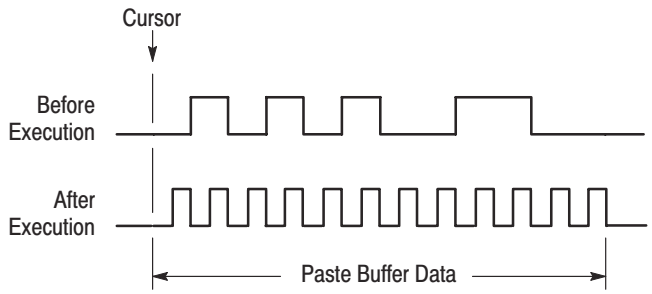


Figure 3-21: Paste – replace

Set Data To High The cursor becomes the area cursor. All the data bits in the editing area are set to 1.

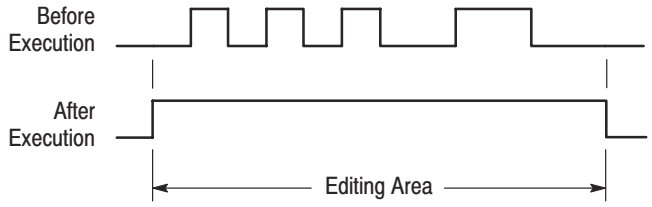


Figure 3-22: Set data to high

For example, this operation will set the value of a 3-bit group data item to 7H (hexadecimal).

Set Data To Low The cursor becomes the area cursor. All the data bits in the editing area are set to 0.

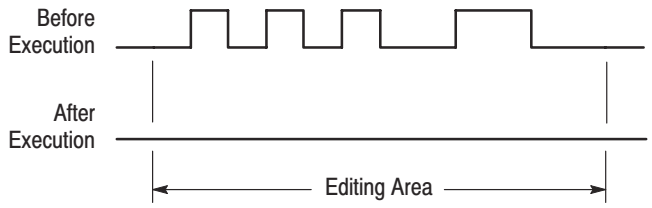


Figure 3-23: Set data to low

Insert High Data The cursor becomes the area cursor. The data following the cursor is moved to the rear by the amount specified for the editing area and the data in the editing area is set to 1.

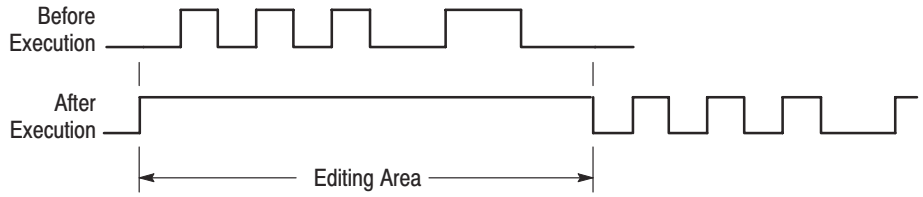


Figure 3-24: Insert high data

Insert Low Data The cursor becomes the area cursor. The data following the cursor is moved to the rear by the amount specified for the editing area and the data in the editing area is set to 0.

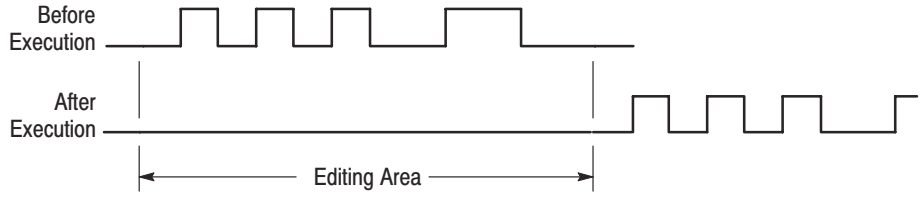


Figure 3-25: Insert low data

Invert Data The cursor becomes the area cursor. The data in the editing area is inverted, i.e. 0 becomes 1, and 1 becomes 0.

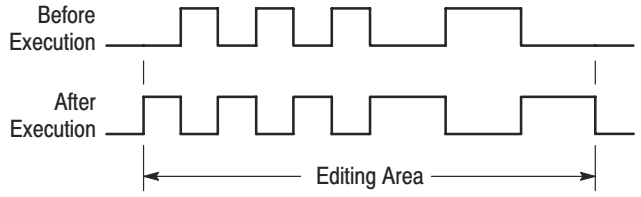


Figure 3-26: Invert data

For example, this operation will set the value of a 3-bit group whose original value was 4H (hexadecimal) to 3H.

Original data: 100 (binary) (= 4H)

Inverted data: 011 (binary) (= 3H)

Mirror Vertical

The function described here is for timing display format. The cursor becomes the area cursor. The area specified as the editing area is reordered in the group/bit direction in a mirror-image manner. This editing operation operates on bit units regardless of any group definitions. In display formats other than timing display (i.e., table and binary), the reordering is performed in the point direction.

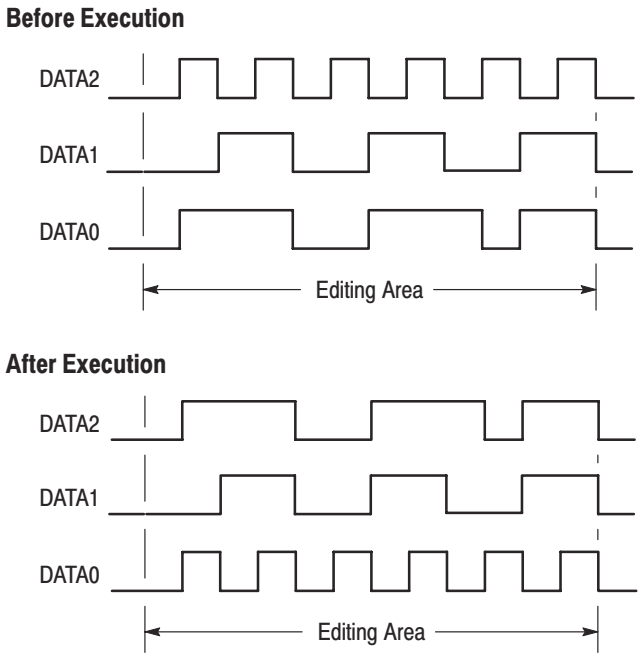


Figure 3-27: Mirror vertical

Mirror Horizontal

This function is for timing display format. The cursor becomes the area cursor. The area specified as the editing area is reordered in the point direction in a mirror-image manner. In display formats other than timing display (i.e., table and binary), the reordering is performed in the group/bit direction.

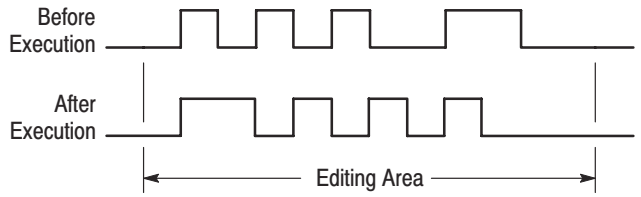


Figure 3-28: Mirror horizontal

Magnify

The cursor becomes the area cursor. The data in the area specified as the editing area is magnified in the direction of the time axis. This function has one parameter, the magnification factor (**Mag Factor**). This can be set to any integer from 2 to 100.

For example, if **Mag Factor** is 2, then magnifying a data range with the data 0101 would give the data 00110011. This editing operation repeats each data item the number of times specified by the **Mag Factor** parameter.

The data following the edit area is moved to the rear from the editing area by the amount of the data increased due to the magnification. The data in the tail that exceeds the memory size is lost.

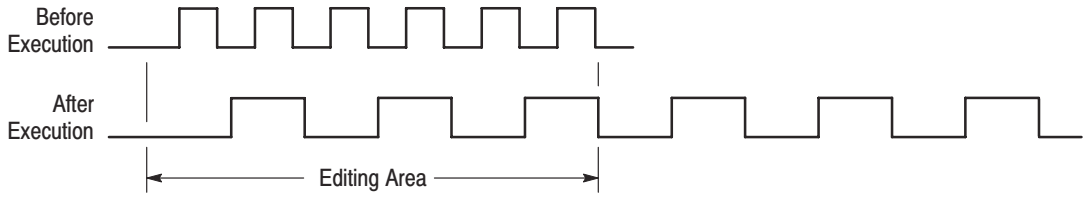


Figure 3-29: Magnify

Numeric Input

The cursor switches to the point cursor, and the input position is indicated on the display. Data can then be changed by input of numeric values. As data is input, existing data at the input position is overwritten.

After selecting **Numeric input** from the **Action Menu**, step is set using the **Points/Step** popup window. A 'step' is the number of points that are set for each number that is input.

Then, the **EXECUTE** button is pressed to start input. Front panel keys are then pressed to set the required data values. The kind of input that is possible differs according to the display format, as shown in Table 3-8.

Table 3-8: Numeric input differences

Display Method	Input Position	Numeric Input Type
Timing	Display of that group data value is selected.	Hexadecimal
Table	Data at the object position is displayed highlighted (bright).	Hexadecimal
Binary	Data at the object position is displayed highlighted (bright).	Binary

Note that depending on how many bits there are in the group at which the input is currently directed, it is sometimes not possible to input the full range of hexadecimal digits. For instance, if the group is only three bits wide, it is not possible to input a digit larger than 7.

Input of each data value finishes, and the data is set, when the number of input digits is sufficient to set all the bits in the group. There is no need to press the enter button.

When the scope is only one group deep (or one bit deep for binary format), the cursor moves along the data by the number of points in a step for each input operation. The next input operation will then set the data at the new cursor position for the same group.

However, when the scope is more than one group deep (or more than one bit deep for binary format), the cursor does not immediately move. Instead, the next input action will be directed at the next group down (or to the right). Only when input to the last group in the scope is complete does the cursor move along the data.

Operation. Actions for performing numeric input

Bottom button	Popup menu	Side button	Front Panel button
Executed Action	Numeric input	OK	
Set the Points/Step using the general purpose knob.			
		OK	EXECUTE
Input data using numeric keys.			

Shifting

The DG2030 provides several methods for the shifting of data in timing, table, or binary display.

Timing. In timing display you can shift data using any one of the following:

- Shift left (add zero)
- Shift right (add zero)
- Shift left
- Shift right

The cursor becomes the area cursor. The data inside the editing area is shifted one point to the left or right. Data that overflows the edit area is lost. If you select any one of the add zero selections, zeros are added at the right or left. If you select shifting without adding zeros, values added at the right or left are equal to the right or left-most values for each bit in the edit area when shifting started.

Figures 3-30, 3-31, 3-32, and 3-33 illustrate the different shifting selections for timing.

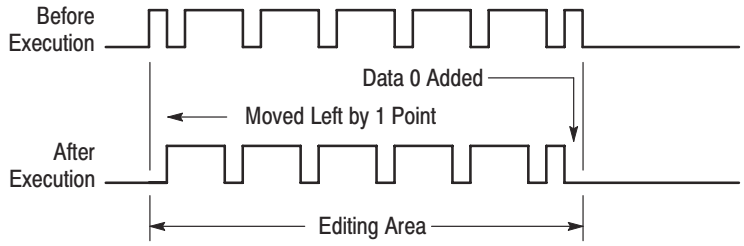


Figure 3-30: Shift left (add zero)

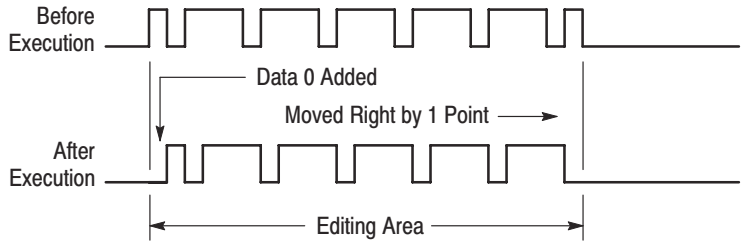


Figure 3-31: Shift right (add zero)

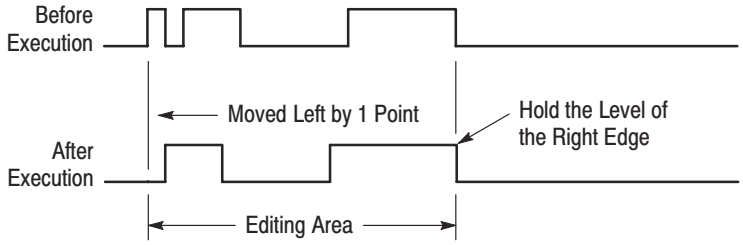


Figure 3-32: Shift left

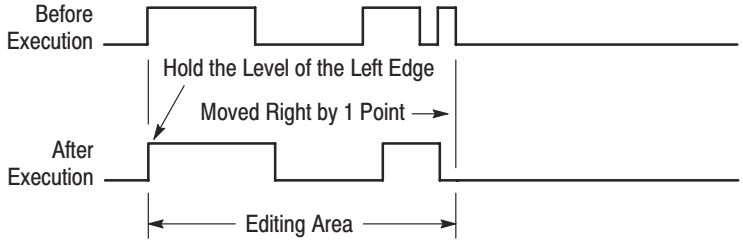


Figure 3-33: Shift right

If a shifting operation is selected when the **Select arrow key function** item is selected in the **Settings** menu, data can be shifted to the left or right with the arrow buttons.

Table and Binary. In the table and binary displays you can shift data using any of the following:

- Shift up (add zero)
- Shift down (add zero)
- Shift up
- Shift down

The cursor becomes the area cursor. The data inside the editing area is shifted one point up or down. Data that overflows the edit area is lost. If you select any one of the add zero selections, zeros are added to the top or bottom. If you select shifting without adding zeros, values added at the top or bottom are equal to the top or bottom-most values for each bit in the edit area when shifting started.

If a shifting operation is selected when the **Select arrow key function** item is selected in the **Settings** menu, data can be shifted up or down with the arrow buttons.

Rotating

The DG2030 provides several methods for rotating data in timing, hexadecimal, or binary display.

Timing. In timing display you can rotate data using any one of the following:

- Rotate left
- Rotate right

The cursor becomes the area cursor. The data inside the editing area is rotated one point to the left or right. Data that overflows the editing area cycles around and is added at the left or right of the edit area. Figures 3-34 and 3-35 illustrate the different rotating selections for timing.

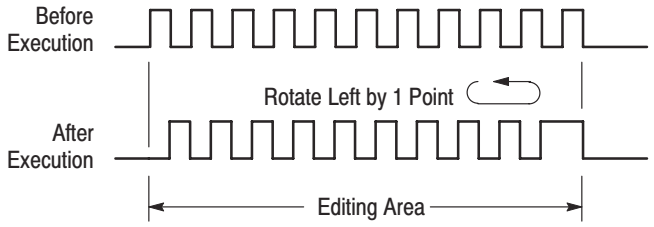


Figure 3-34: Rotate left

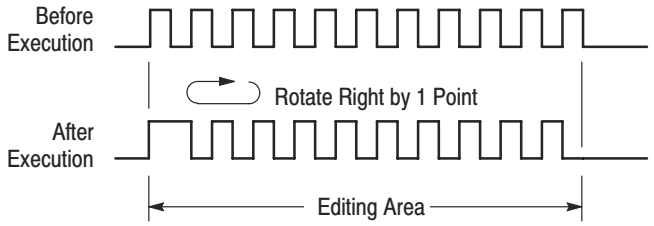


Figure 3-35: Rotate right

If **Rotate region left/right** is selected when the **Select arrow key function** item is selected in the **Settings** menu, data can be rotated to the left or right with the arrow buttons.

Table and Binary. In the table and binary displays you can rotate data using any of the following:

- Rotate up
- Rotate down

The cursor becomes the area cursor. The data inside the editing area is rotated by one point up or down. Data that overflows the editing area cycles around and is added to the top or bottom of the edit area.

If **Rotate region up/down** is selected when the **Select arrow key function** item is selected in the **Settings** menu, data can be rotated to the up or down with the arrow buttons.

Creating Standard Pattern Data

Table 3-9 and Figure 3-36 present descriptions and examples of the standard pattern data.

Table 3-9: Standard pattern data descriptions

Standard pattern data	Description
Binary up counter	Creates a binary up counter data pattern. The cursor becomes the area cursor. The number of bits in the counter is the total number of bits in the group set up with the Set scope item in the Execute Action menu. When Binary up counter is selected, the instrument asks for the Points/Step value. This value sets the number of data points per counter step. When the counter reaches its maximum value, the value returns to 0 and it repeats the count-up operation.
Binary down counter	The use is the same as Binary up counter. The action is the same except that a binary down counter is created., and when the counter reaches 0, the value returns to its maximum value and it repeats the count-down operation.
Johnson counter	Creates a Johnson counter data pattern. When this menu item is selected, the instrument asks for the Points/Step value. This value sets the number of data points per counter step.
Graycode counter	Creates a Gray code counter data pattern. When this menu item is selected, the instrument asks for the Points/Step value. This value sets the number of data points per counter step.

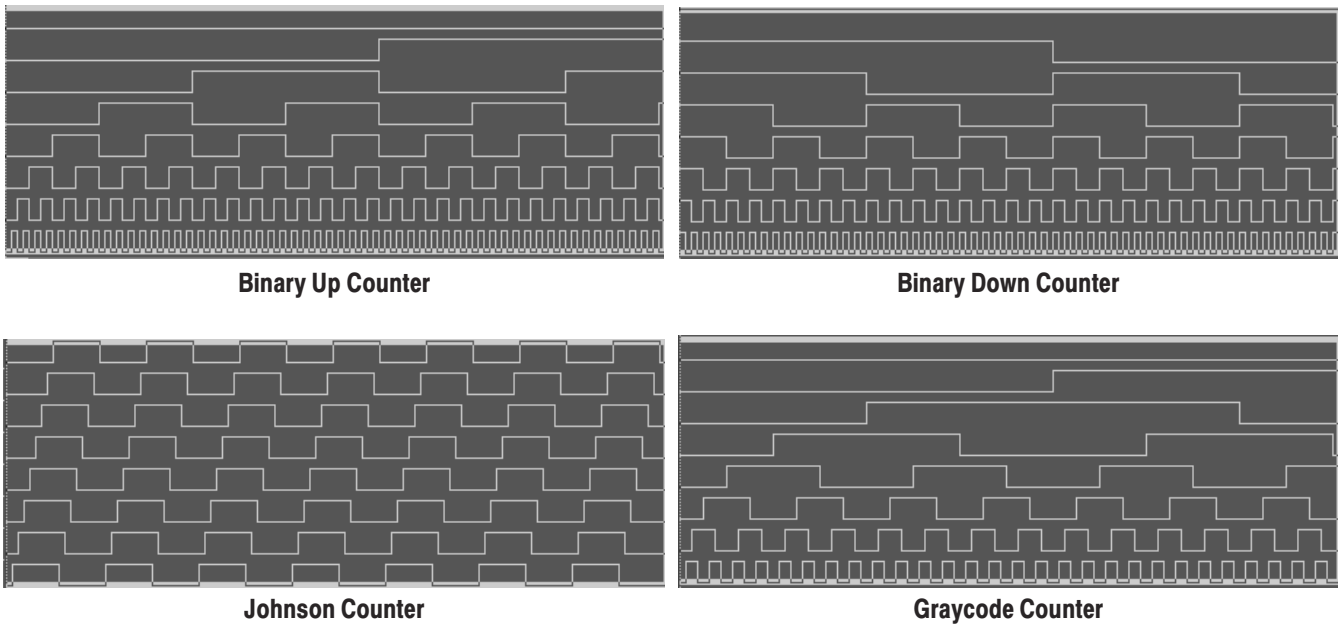


Figure 3-36: Standard pattern data

Operation. Creating the standard pattern data

Bottom button	Popup menu	Side button
Set the editing range in the point direction.		
Set the editing range in the group/bit direction.		
Execute Action	Select from the following items. Binary up counter Binary down counter Johnson counter Graycode counter	OK

Enhanced Action Menu

The **Enhanced Action** menu uses special editing functions. When **All** is selected from the **Region** side menu the whole area is edited, and when **Entered** is selected from the **Region** side menu, **From** and **Size** parameters can be specified.

Clock Pattern

Generates a clock pattern. The edit object can be any bit. Figure 3-37 shows the creation of a clock pattern enclosed in a frame and the generation of the pattern in the target bit.

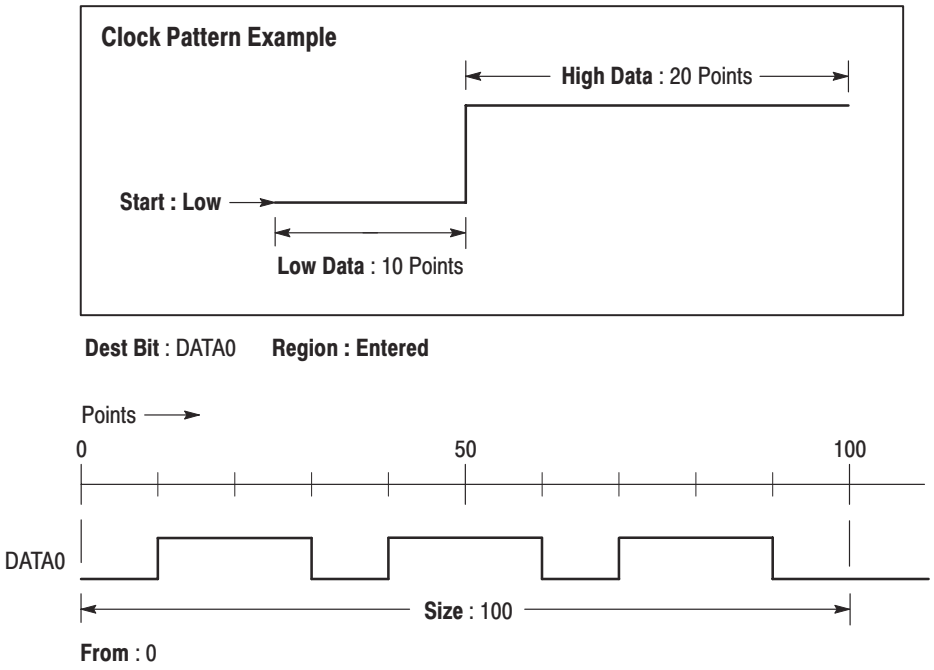


Figure 3-37: Creating the clock pattern

Popup Menu.

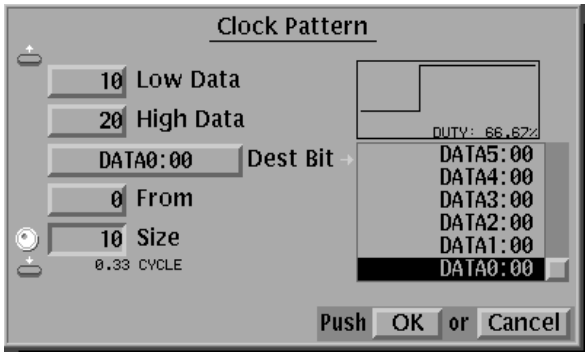


Figure 3-38: Clock Pattern popup menu

Table 3-10 describes the parameter items.

Table 3-10: Parameter Items

Parameter item	Function
Low Data	The length (number of points) of the data 0 part of the clock pulse. The maximum is 100 points.
High Data	The length (number of points) of the data 1 part of the clock pulse. The maximum is 100 points.
Dest Bit	The bit in which to write the pattern.
From	When Entered was selected in the Region side menu item, specifies the first point in the bit from which the pattern is written.
Size	When Entered **w**as selected as the Region **sid**e menu item, specifies the length (number of points) of the clock pattern.

Side Menu

Menu item	Function
Start	Determines the state at pulse start. When **Low** is selected, the value will be 0. When High is selected, the value will be 1.
Region	The values All and Entered can be set. When All is selected, all of the Dest Bit memory is filled with the pattern. When Entered is selected, the pattern is written to the area specified by the **From** and **Size** parameters.

Operation. Generate a clock pattern

Bottom button	Popup menu	Side button
Enhanced Action	Clock Pattern	OK
		Region (Select All or Entered)
		Start (Select Low or High)
Set the parameters in the popup menu. (Low Data, High Data, Dest Bit, From, Size)		
		OK

Shift Register Generator

Sets up the configuration for the pseudo random pulse generator that uses a shift register.

The shift register pseudo random pulse generator consists of a register with between 1 and 32 bits and a feedback loop. This feedback loop takes the value that is shifted out of the register, performs the exclusive OR with one or more bits within the register, and places the result in the first bit of the register. The position at which an exclusive OR is set is called a tap, and certain tap configurations produce series that are the longest possible. The data generated by such a configuration is called an M-series. If the number of stages in the shift register is n, then an M-series pseudo-random signal will have a length of 2^n–1.

Create a simple register and tap setup as follows:

- Register length: 3
- Register value: 101
- Set the tap with the **Maximum Length Taps** item.

Figure 3-39 shows the output for the above settings.

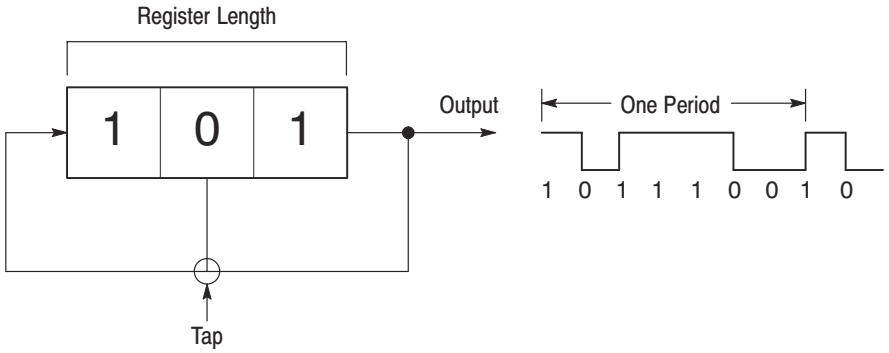


Figure 3-39: Register value and tap setting example

Popup Menu.

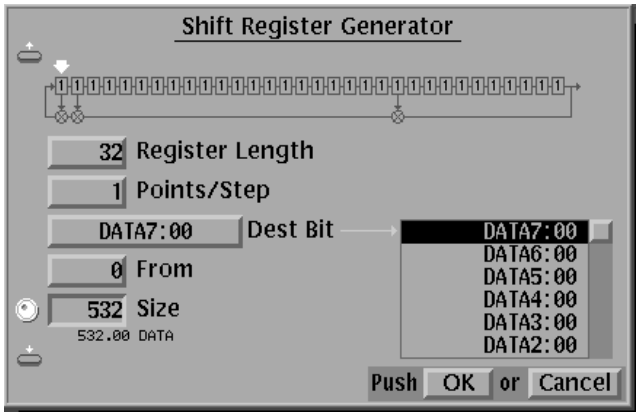


Figure 3-40: Shift Register Generator popup menu

Table 3-11 describes the parameter items.

Table 3-11: Shift register generator parameters

Parameter	Function
Register Diagram	Use the 0 and 1 numeric keys to set the register's initial value. Use the "–" button to toggle taps.
Register Length	Sets the register length. The register length can be set to a value between 1 and 32.
Points/Step	The number of data points set for each shift of the register.
Dest Bit	The bit to which the pattern is written
From	When Entered was selected in the Region side menu item, specifies the first point from which the pattern is written.
Size	When Entered was selected in the Region side menu item, specifies the number of points into which the pattern is written.

Side Menu

Item	Function
Set All Registers	Sets the value of all the register bits to 1.
Maximum Length Tap	Sets the taps to positions such that the output becomes a tap M-series for the current register length. There are multiple tap combinations for M-series bit series. Each time the Maximum Length Tap button is pressed, the tap combination changes.
Region	The values All and Entered can be set. When All is selected, all of the Dest Bit memory is filled with the pseudo-random pulse pattern. When Entered is selected, the pattern is written to the area specified by the From and Size parameters.

Operation. Set the register value input and taps

Bottom button	Popup menu	Side button
Enhanced Action	Shift Register Generator	OK
		Region (Select All or Entered)
Set the parameters in the popup menu. (Register Length, Points/Step, Dest Bit, From, Size)		
Use the general purpose knob to select bits for setting in the register.		
Set the value of a bit in the register with the 0 and 1 numeric keys.		
Set the tap on/off state for a bit using the “–” numeric key.		
		OK

Logical Operation

Performs a logical operation between pattern data in two (source) bits, and replaces the data in a destination bit with the result. Figure 3-41 shows an example of a logical operation where the **AND** operator was selected.

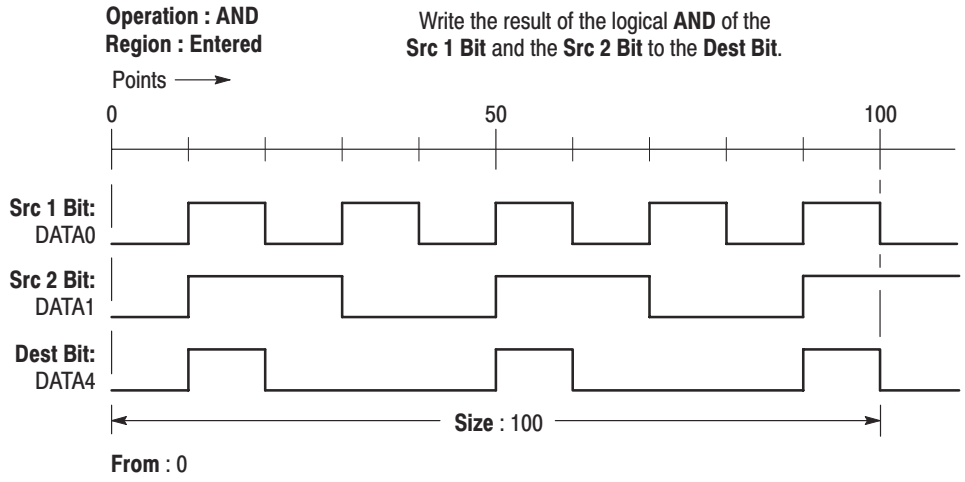


Figure 3-41: Logical AND Operation Example

Popup Menu.

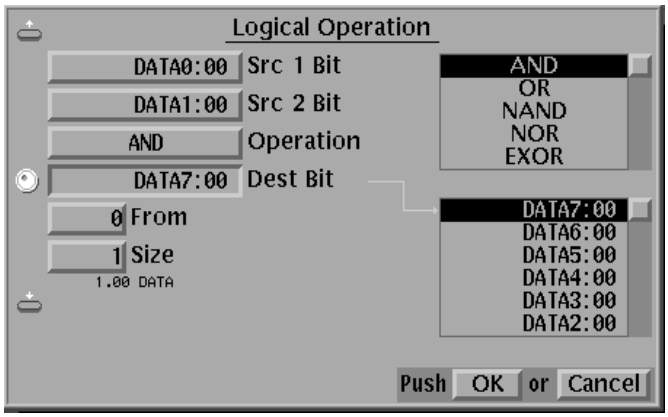


Figure 3-42: Logical Operation popup menu

Table 3-12 describes the parameter items.

Table 3-12: Logical operation parameters

Parameter	Function	
Src 1 Bit	Specifies a bit that will be used as an operand to the operation.	
Src 2 Bit	Specifies the other bit that will be used as the other operand to the operation.	
Operation	Specifies the type of the operation.	
	Selection item	**Description**
	AND	Logical AND
	OR	Logical OR
	NAND	Logical NAND
	NOR	Logical NOR
	EXOR	Logical exclusive OR
	EXNOR	Logical exclusive NOR
Dest Bit	The bit to which the result pattern is written	
From	When Entered was selected in the Region side menu item, specifies the first point in the bit from which the pattern is written.	
Size	When Entered was selected in the Region side menu item, specifies the number of points in the bit in which the pattern is written. The Maximum 9999 points can be entered. Entering 0 causes to quit the popup menu.	

Operation. Apply a logical operation to two data items

Bottom button	Popup menu	Side button
Enhanced Action	Logical Operation	OK
		Region (Select All or Entered)
Set the parameters in the popup menu. (Src 1 Bit, Src 2 Bit, Operation, Dest Bit, From, Size)		
		OK

Bit Operation Copies or moves data between bits in the specified area.

Popup Menu.

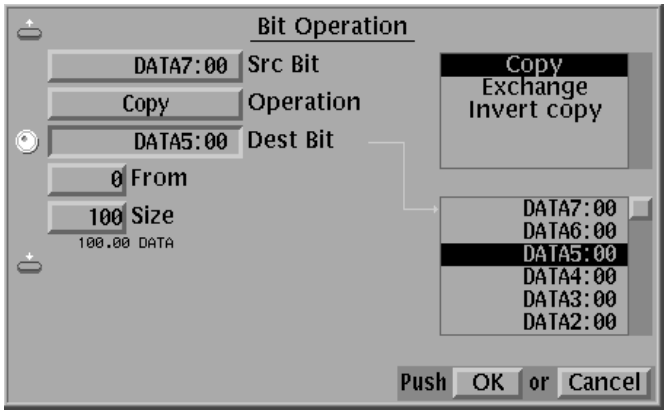


Figure 3-43: Bit Operation popup menu

Table 3-13 describes the parameter items.

Table 3-13: Bit operation parameters

Parameter	Function	
Src Bit	Specifies the source data for the operation.	
Operation	Specifies the type of the operation.	
	Selection item	**Description**
	Copy	Copies the data, overwriting the destination data.
	Exchange	Exchanges the data in the source and destination bits.
	Invert copy	Copies the data. However, logically inverts the data before overwriting the destination data.
Dest Bit	The bit to which the pattern is written.	
From	When Entered was selected in the Region side menu item, specifies the first point in the bit from which the pattern is written.	
Size	When Entered was selected in the Region side menu item, specifies the number of points in the bit in which the pattern is written. The Maximum 9999 points can be entered. Entering 0 causes to quit the popup menu.	

Operation. Move or copy pattern data

Bottom button	Popup menu	Side button
Enhanced Action	Bit Operation	OK
		Region (Select All or Entered)
Set the parameters in the popup menu. (Src Bit, Operation, Dest Bit, From, Size)		
		OK

Serial Code Converter

Converts data in the source by writing specified output data to the destination as one of a set patterns is found in the source data.

Refer to *Conversion Table Examples* on page C-6 for examples of how to convert pattern data to different format.

Popup Menu. The menu for setting the bit and area that will be the code conversion source data, and the bit and area where the result of the code conversion will be written is displayed using the following operation. (See Figure 3-44.) Select the item with the up and down arrow buttons, and use the general purpose knob and the numeric keys to set the parameter value.

Bottom button	Popup menu	Side button
Enhanced Action	Serial Code Converter	OK

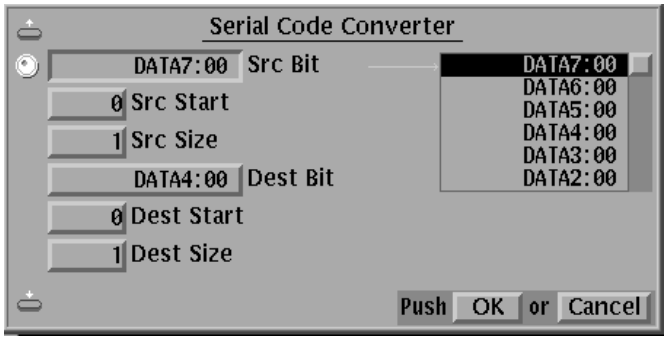


Figure 3-44: Serial Code Converter menu

Table 3-14 describes the parameter items.

Table 3-14: Serial code converter parameters

Parameter	Function
Src Bit	Specifies the bit from which the source data will be read.
Src Start	Specifies the point from which reading the source data will begin.
Src Size	Specifies the number of points of source data that will be read.
Dest Bit	Specifies the bit into which the converted data will be written.
Dest Start	Specifies the point from which converted data will be written.
Dest Size	Specifies the number of points of converted data that will be written.

Pressing the **OK** side button starts the conversion.

Side Menu

Menu item	Function
Load Table Data1	Reads in a code conversion table from mass memory. The file will be an ASCII file with the extension .TBL. The operation is identical to that for Load Data & Setup from the File menu.
Save Table Data	Writes a code conversion table to mass memory. The file must be an ASCII file with the extension .TBL. The operation is identical to that for Save Data & Setup from the File menu.
Edit Table Data	Edits a code conversion table. This is explained below.

Code Conversion Table Editing. Figure 3-45 shows the **Edit Code Table** menu, which is displayed when the **Edit Table Data** side menu item is selected. The **SOURCE CONDITION** section of this table defines the templates used for pattern matching. The instrument compares these templates with data sequences in the source data to find matching patterns.

***NOTE**. The data code conversion table files are arranged in essentially the same manner as displayed on the table editing screen. In these files a comma is used to delimit fields, and CR+LF to delimit lines. No spaces appear in the file.*

Pattern matching is performed in order starting at the top of the table. Pattern matching is more reliable if templates with more bits (longer templates) appear towards the top of the table.

The matching process moves along the input data as follows. The current position is set to the start point, and the table is used to find a match for the data at that position. When a match is found, the output code for that template is written to the destination. The current position is then moved on by the width of the pattern in the **CURRENT** column. The process then repeats.

This continues until the destination is full. If the end of the input data is reached before the destination is full, the current position returns to the start point in the source data.

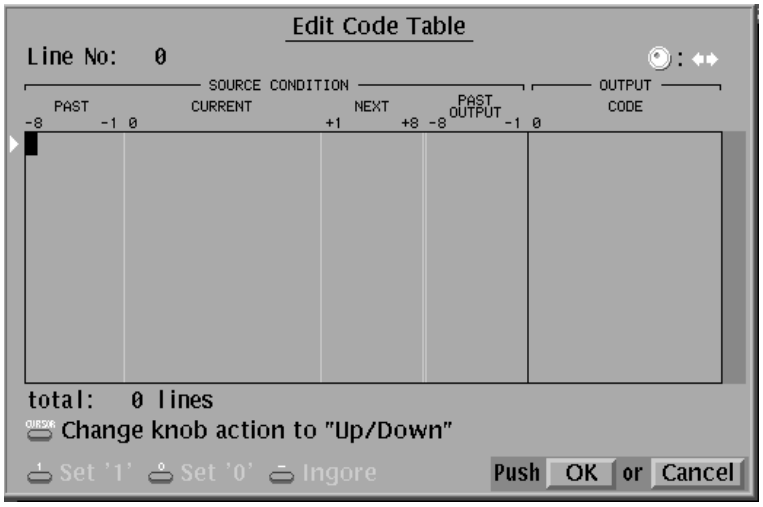


Figure 3-45: Edit Code Table menu

Table 3-15 describes the parameter items in the **Edit Code Table** menu.

Refer to *Conversion Table Examples* on page C-6 for examples of how to convert pattern data to different format.

Table 3-15: Edit Code Table parameters

Parameter	Function
PAST	For the template to match, the data in the source immediately behind the current position (i.e. data that has already been read) must match this pattern.
CURRENT	For the template to match, the data in the source at the current position must match this pattern.
NEXT	For the template to match, the data in the source at a position ahead of the current position by the width of the pattern in the CURRENT column must match this pattern.
PAST OUTPUT	For the template to match, the data at the end of the destination (i.e. most recently written data) must match this pattern.
OUTPUT CODE	When the whole template matches, the data specified in this column is written to the destination.

Sub Menu

Item	Function
Insert Empty Line	Inserts an empty line before the line currently indicated by the block cursor.
Delete Line	Deletes the line currently indicated by the block cursor.
Delete All Lines	Deletes all lines in the table.

***NOTE**. The maximum size of the table data is 1024 lines.*

Operation. The procedure for editing a code conversion table is as follows:The four arrow buttons are used to move the cursor. The general purpose knob can also be used for cursor movement. The **CURSOR** button causes the general purpose knob to switch between controlling vertical and horizontal movement. Use these procedures to move the cursor to the target location and then use the numeric keys to edit the data. Table 3-16 lists the roles of the numeric keys.

Table 3-16: Numeric key description

Numeric Key	Description
0	Sets the table data at the cursor to 0.
1	Sets the table data at the cursor to 1.
–	Sets the table data at the cursor to the don't-care state.

The delete key clears the table data in the area that contains the cursor.

Sometimes, data at positions other than the cursor position may be changed. For example, pressing 0 or 1 near the center of the **SOURCE CONDITION**'s **CURRENT** field when the field is empty changes data from the start of that area to the cursor position.

Make Sequence Menu

A sequence is a function to output blocked pattern data in a predetermined sequence as specified in a sequence table. In the sequence table, repeat count, trigger wait, event jump and calling subsequences are used, as well as placing the blocked patterns in a sequential order.

- The blocked patterns are output in the line-numbered order defined in the sequence table.
- A patterned data or subsequence can be defined in each line in the sequence table.
- A line can be repeated on output from 1 to 65536 times or infinitely.
- A line can wait trigger event for output.
- A line can be jumped to a specified line by the trigger of event signal.

Figure 3-46 shows an example of a sequence. In this example, two subsequences SUB1 waiting trigger event, a blocked pattern data BK1 to be infinitely repeated and jumped to the line 3 on event signal, and blocked pattern data BK4 are defined.

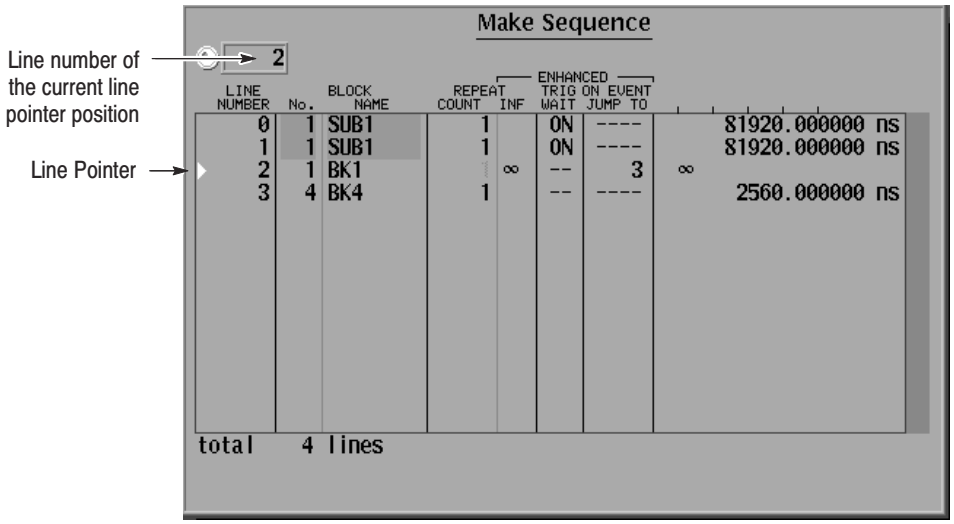


Figure 3-46: Make Sequence menu and a sequence example

***NOTE**. Enhanced columns in Figure 3-46 does not become effective unless the run mode is not set to Enhanced. For enhanced mode, refer to* Run Mode Menu *on page 3-75.*

As already stated, sequence can call subsequences. Each subsequence is composed of blocked patterns with specified repeat count.

Figure 3-47 shows an example of a subsequence. This subsequence is called by the sequence shown in Figure 3-47.

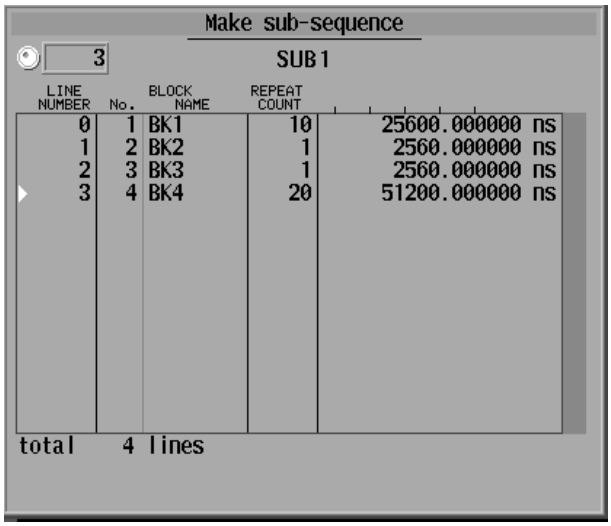


Figure 3-47: Make Subsequence menu and a subsequence example

Insert Inserts a new sequence step at the position of the line pointer. In the Make Sequence menu, block or subsequence can be inserted in each line. The BLOCK column of the lines inserted with subsequences becomes highlight gray to distinguish from those inserted with blocks, as shown in Figure 3-46.

Operation. Insert a sequence step

Bottom button	Popup menu	Side button
Make Sequence		
Move the cursor to the line where the step is to be inserted using the general purpose knob.		
		Insert
	Select the block.	OK

Delete

Deletes the sequence step at the position of the line pointer.

Operation. Delete a sequence step

Bottom button	Popup menu	Side button
Make Sequence		
Move the cursor to the line where the step is to be deleted using the general purpose knob.		
		Delete

Repeat Count

Sets the block repeat count for the step at the position of the line pointer.

Operation. Set the block repeat count for the step

Bottom button	Popup menu	Side button
Make Sequence		
Move the cursor to the line where the repeat count is to be set using the general purpose knob.		
		Repeat Count (set the repeat count)

Set Enhanced Control

Sets up the sequence control options that become valid when the instrument is in enhanced mode. See the **SETUP→ Run Mode → Enhanced** for the enhanced operation.

Sub Menu

Item	Function
Trig Wait	When set to ON, data output stops when the specified sequence position is reached and the instrument waits for a trigger input.
Event Jump	When set to ON, if an event occurs during output of the specified line, control jumps to the set line.
Jump to	Specifies the jump destination (line number) for the Event Jump function.
Repeat	When Count is selected, that block is repeated the number of times specified by the Repeat Count setting. When Infinite is selected, the block is repeated indefinitely.

Special

Deletes and registers sequences.

Sub Menu

Item	Function
Delete All	Deletes all sequences.
Make Simple Sequence	Registers all currently defined block in order as a sequence.
Edit Sub-Sequence	Creates or edits subsequence. This subsequence can be included in the sequence and will be expanded into the sequence when executed. A subsequence can be created and edited as is performed for the sequence using the reduced menu structure. Only block and repeat count can be defined in the subsequence. Refer to *Creating and Editing Subsequences* described in the next paragraph.

Creating and Editing Subsequences

You can newly create a subsequence or edit existed a subsequence. Use the menu items under the **Edit Sub-sequence** menu item.

Item	Function
New	Newly creates a subsequence. When the New is selected, the Make Sub-Sequence popup menu and the side menu including Insert, Delete, Repeat and OK appear. Use these menu items to create a subsequence.
Open	Opens a subsequence to be edited. When the Open is selected, the popup menu for subsequence selection list brings up. Select a subsequence from the list, then the Make Sub-Sequence popup menu and the side menu including Insert, Delete, Repeat and OK appear. Use these menu items to edit the subsequence.
Remove	Removes a subsequence. When the Remove is selected, the popup menu for subsequence selection list brings up. Select a subsequence to be removed.
Clear	Removes all existed subsequences.

Limitations on Using Subsequences

The following list describes limitations on using subsequences:

- Each line can contain only one data pattern block
- Each line can be repeated up to 65,536 times
- Each subsequence can contain up to 256 lines
- You can define up to 50 subsequences

Sequence memory usage. Sequence memory controls the maximum number of subsequence calls and their repeat counts that can be run. When you run a sequence, the DG2030 compiles the sequence and subsequence lines into internal codes that are stored in the sequence memory. The DG2030 then uses the sequence memory code to output the block data. There is one internal code item for each sequence line except for lines that contains a subsequence call.

For subsequence calls without a repeat count, the DG2030 compiles a number of internal code items equal to the number of lines in the subsequence.

For subsequence calls with a repeat count, the DG2030 compiles a number of internal code items equal to the repeat count for that subsequence call times the number of lines in the subsequence. For example, if a sequence line has a subsequence call with the repeat count of 25 and that subsequence has two lines, the DG2030 generates 50 internal code items for that sequence line and stores them in the sequence memory. This occurs for each subsequence call. Figure 3-48 illustrates how the DG2030 compiles the sequence and subsequences into the internal codes and stores them in the sequence memory.

Defining subsequence calls with large repeat counts can generate internal code that consumes a large amount of sequence memory. This can result in insufficient memory errors. The DG2030 does not check for sequence memory availability errors. If you run a sequence and the DG2030 displays a memory error message, reduce the number of subsequence calls, number of repeat counts and/or number of lines in the subsequences.

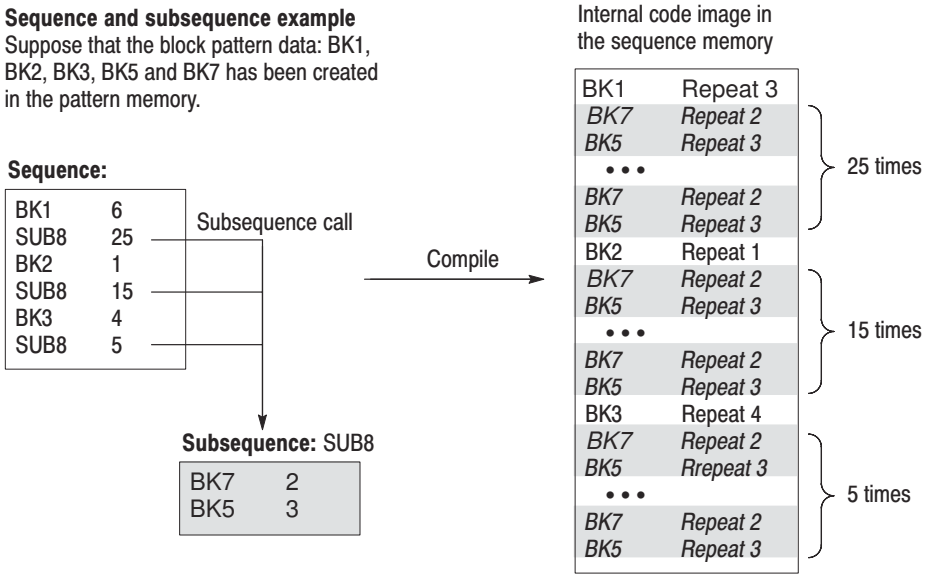


Figure 3-48: Example of a sequence expanded into sequence memory

About Event Jump

In enhanced mode the sequence program can jump to the line number set in the **Event Jump** field in response to an event input from the rear panel connector when the output reaches the end of the block in the block field. This is called the event jump function.

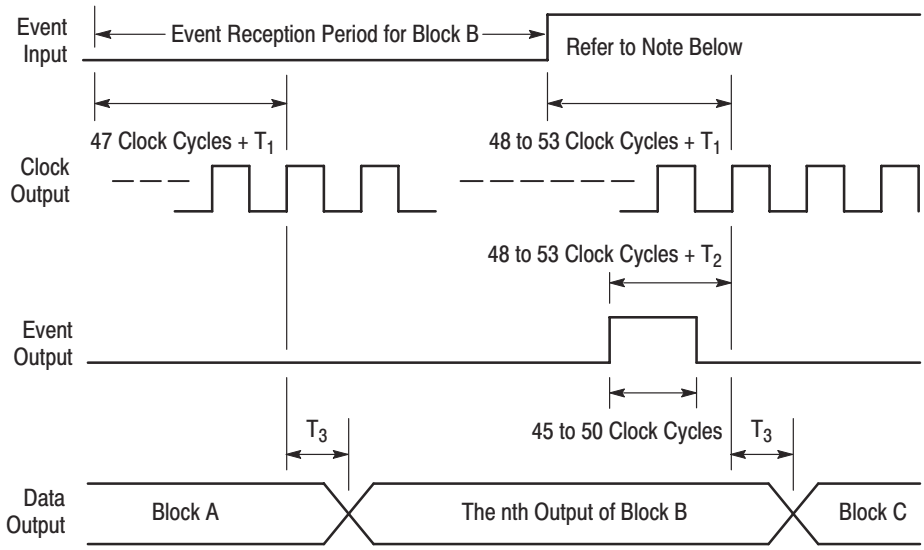
The event jump function can be applied to any line in the sequence program with the **Make Sequence → Set Enhanced Control → Event Jump** menu item.

In enhanced mode, after the block data for a sequence program for which the event jump function has been set has finished outputting, the DG2030 determines whether to perform an event jump.

The fact that an event request occurred is stored in a flip-flop in the pattern control circuit when either a low level to high level transition occurs in the event input, or the front panel **STEP/EVENT** button is pressed.

Then, when the end of the output of the block in a line for which the **Event Jump** item is set approaches, the DG2030 checks the state of that flip-flop, activates the event jump operation, and clears the flip-flop. Keep it in mind that, even in the trigger wait state and during the output of data for a block for which the **Event Jump** item was set to off, a rising edge in the signal applied to the event input is seen as an event request, and causes the next event jump operation to occur.

The event jump operation occurs even if the block pattern has not been output for the number of repeats set in the sequence program. When an event jump operation occurs, a positive TTL-level pulse 40 to 50 clocks wide is output from the front panel event output connector 48 to 53 clocks before the block pattern switches.



n: A value between 1 and the value determined by the iteration count
T_1: The event input delay time
T_2: The event output delay time
T_3: The delay time between clock output and data output

Note: If an event exists before the event out starts rising, the event jump will be made at the next block. If the the event is coming after the event out starts rising, the event jump will be performed at the block after the next block.

The number of clock varies depending on the pattern size of that block. This is because the clock is generated from the ECL clock circuit by dynamically dividing into 9 or 10 cycles.

Figure 3-49: Event jump operation timing

Undo

Reverses editing operations performed on the data. Immediately after the Undo function is used, executing **Undo** again executes the reversed editing operation.

Setup Menu

The bottom menu for the **SETUP** menu includes the **Group Assign**, **Output Condition**, **Level Condition**, **Timing Condition**, **Run Mode**, **Trigger**, and **Clock** items. This section describes these items. Table 3-17 lists the functions of the **SETUP** menu items and the pages where their documentation appears.

Table 3-17: SETUP menu functions

Bottom	Side or popup menu		Function	Page
Group Assign	Add Group		Adding a group	3-66
	Delete Group		Deleting a group	3-67
	Rename		Renaming a group	3-68
	Group Bit(s) Config		Changing a group's bit configuration	3-68
	Reset All bits Assign		Deleting a group definition	3-68
Output Condition	Assign Condition		Assigning data bit to output channel	3-69
	Control Condition	Event Level	Setting the event control input level	3-70
		Event	Setting the event control to enable or disable	
		Inhibit Level	Setting the inhibit control input level	
		Change Inhibit Control	Selecting an inhibit control on each output channel	
Level Condition	High		Setting the output high level	3-72
	Low		Setting the output low level	3-72
	Z on Stop		Setting the output impedance when output is stopped	3-73
Timing Condition	Rise		Adjusting the slope of edges	3-73
	Fall			
	Delay		Setting the delay timing	3-75
Run Mode	Repeat		Selecting a run mode	3-75
	Single			3-76
	Step			3-77
	Enhanced			3-77
	Update		Setting the data update method	3-78
Trigger	Slope		Selecting a trigger slope	3-79
	Trigger Level		Setting the trigger level	3-79
	Impedance		Setting the trigger input impedance	3-80

Table 3-17: SETUP menu functions (Cont.)

Bottom	Side or popup menu		Function	Page
Trigger	Source		Selecting a trigger source	3-80
	Interval	State	Specifying the trigger interval.	3-80
		Time		
Clock	Source		Setting the clock source	3-81
	Int Frequency		Setting the internal clock frequency	3-81
	Ext Frequency		Inputting an external clock frequency	3-81
	PLL		Setting up the PLL circuit	3-82

Setup Display

This section describes the **SETUP** menu screen. Figure 3-50 shows the menu. Table 3-18 provides descriptions and page number references.

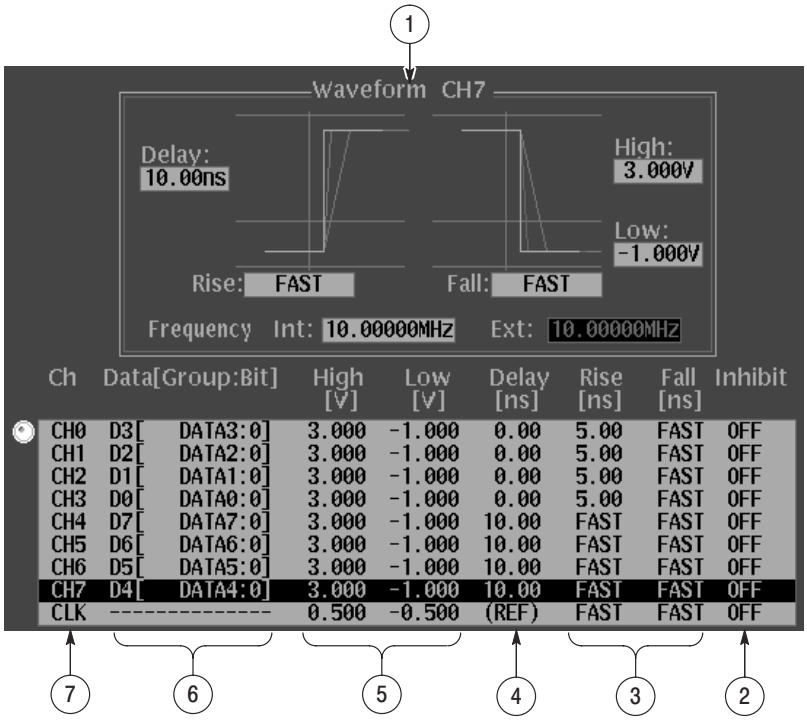


Figure 3-50: SETUP menu display

Table 3-18: Setup menu display

Screen reference	Function	Page
1	Shows the pulse parameters set for a selected output channel and frequency currently set.	3-73
2	Shows the method selected for data output high-impedance control.	3-70
3	Shows the settings of the raise and fall time for each channel. As referring to the displayed pulse image, the raise and fall time can be set for the pulse pattern on each channel.	3-73
4	Shows the output delays. Delays can only be set for each output channel.	3-75
5	Shows the high and low values of the output voltage. These voltages can be set to arbitrary values between –1.5 and 3 V.	3-72
6	Shows the data bits and the group to which each data bit belongs.	3-66
7	Shows the output channel. The channels are labeled numbered 0 through 7.	–

Group Assign Menu

This menu is used to define groups for data bits. Up to 8 groups can be defined. The popup menu shown in Figure 3-51 lists the currently defined groups.

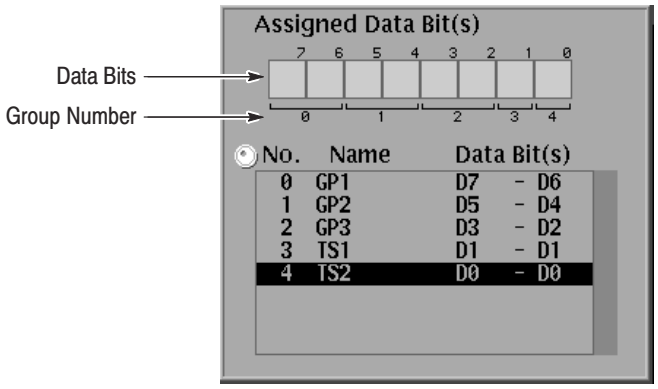


Figure 3-51: Group Assign popup menu

See Figure 2-8 for the group allocation.

Add Group

Adds a new group. A new group cannot be added if there are already 8 groups defined.

Each data bit has a default group name. The default group names are DATA7 for data bit 7, DATA6 for data bit 6, and so on. You can combine several data bits into a new group and define a new group name.

The bit structure of a group is defined by specifying the MSB and LSB of the group. If the bit structure of a new group overlaps with that of an existing group, the newly defined group takes precedence and the structure of the existing group is automatically modified. Figure 3-52 shows an example of a bit structure assignment.

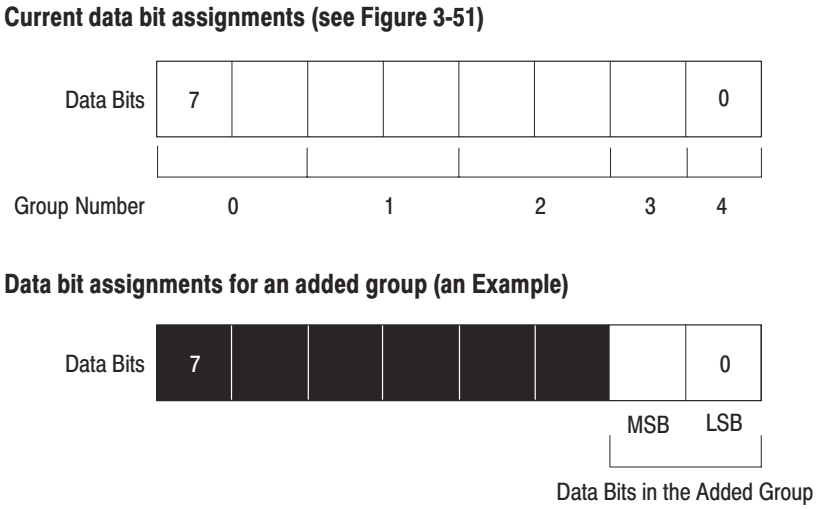


Figure 3-52: Bit structure assignment

Operation. Add a group

Bottom button	Popup menu	Side button
Group Assign		Add Group
	Input the name of the new group.	OK
		MSB (Specify the MSB)
		LSB (Specify the LSB)
		OK
		OK

Delete Group

Deletes the group selected with the cursor. This function asks for confirmation before actually deleting the group.

Operation. Delete a group

Bottom button	Popup menu	Side button
Group Assign	Select the group to be deleted.	Delete Group
		OK

Rename

Changes the name of the group selected with the cursor.

Operation. Rename a group

Bottom button	Popup menu	Side button
Group Assign	Select the group whose name is to be changed.	Rename
	Input a new name.	OK

Group Bit(s) Config

Changes the bit configuration of the group selected with the cursor. If the result of the changed configuration overlaps an existing group, the newly defined group takes precedence.

Operation. Change a group's bit configuration

Bottom button	Popup menu	Side button
Group Assign		Group Bit(s) Config
		MSB (Specify the MSB)
		LSB (Specify the LSB)
		OK

Reset All bits Assign

Deletes the currently defined group definitions and returns the group settings to the initial state. (See Appendix C.)

Operation. Delete a group definition

Bottom button	Popup menu	Side button
Group Assign		Reset All bits Assign
		OK

Output Condition Menu

This menu defines which data bits are assigned to which output channel. The menu lists the data bits at the right and the output channels at the left (see Figure 3-53). Use the general purpose knob to select data bits and the up and down arrow buttons to select output channels.

Assign Condition

Assigns the selected data bit to the selected output channel. The currently set value is overwritten.

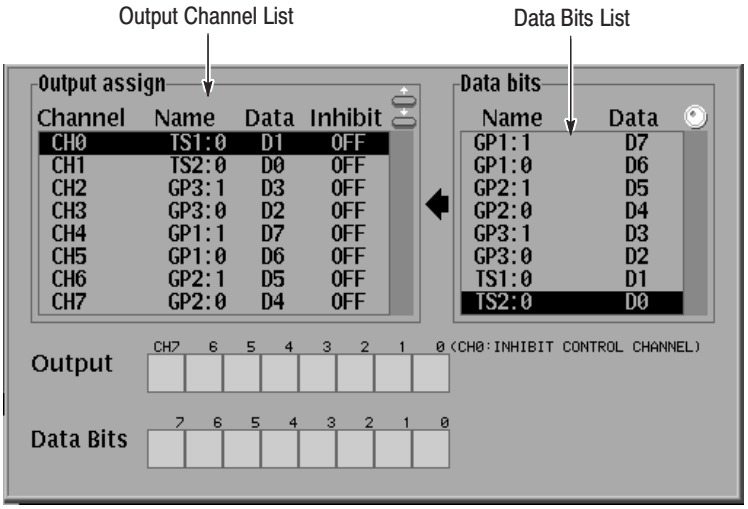


Figure 3-53: Output channel assign popup menu

See Figure 2-8 for the output channel allocation.

Sub Menu

Item	Function
Assign	Assigns the selected data bit to the selected output channel using the popup menu brought up at the same time as this sub-menu (see Figure 3-53). The currently set value is overwritten.
Release	Clear the data for the selected assignment.

Operation. Assign data bit to output channel

Bottom button	Popup menu	Side button
Output Condition		Assign Condition
Select a data bit with the general purpose knob.		
Select the channel to be assigned using the up and down arrow buttons.		
		Assign

***NOTE**. Note that the settings performed using the **Output Channel Assign** menu do not take effect unless the **OK** button is pressed.*

Operation. Clear output channel assignment

Bottom button	Popup menu	Side button
Output Condition		Assign Condition
Select the channel for which the data assignment is to be cleared using the up and down arrow buttons.		
		Release

Control Condition

Sets the control method used to set output channels to the high-impedance state. Table 3-19 shows the four high-impedance state control methods that can be selected for each channel.

Sub Menu

Item	Function
Event Level	Sets the event control input threshold level. This level can be set in the range –5 to +5 V.
Event	Enables or disables the event control.
Inhibit Level	Sets the inhibit control input threshold level. This level can be set in the range –5 V to +5 V.
Change Inhibit Control	Sets the control method used to set output channels to the high-impedance state. Table 3-19 shows the four high-impedance state control methods that can be selected for each channel.

Operation. Set the event input level

Bottom button	Popup menu	Side button
Output Condition		Control Condition
		Event Level (Set the event level)

Operation. Enable or disable the event control

Bottom button	Popup menu	Side button
Output Condition		Control Condition
		Event (Select Enable or Disable)

Operation. Set the inhibit level

Bottom button	Popup menu	Side button
Output Condition		Control Condition
		Inhibit Level (Set the inhibit level)

Operation. Select an impedance state control method

Bottom button	Popup menu	Side button
Output Condition		Control Condition
Select the channel to be set up for high-impedance control with the up and down arrow buttons.		
		Channel Inhibit Control
	Select one of Off, Internal, External, and Both.	
		OK

Table 3-19: Impedance state contol methods

Selection item	Description
OFF	No high-impedance control (output is always enabled)
Internal	Controlled by the channel 0 signal (high-impedance when high)
External	Controlled by an external impedance control signal (high-impedance when high)
Both	Controlled by both the channel 0 and external impedance control signals (high-impedance when either signal is high)

Since the channel 0 signal for each output cannot control its own high-impedance state, these channels must be set to either **OFF** or **External**. Figure 3-54 shows a schematic overview of the high-impedance control circuit.

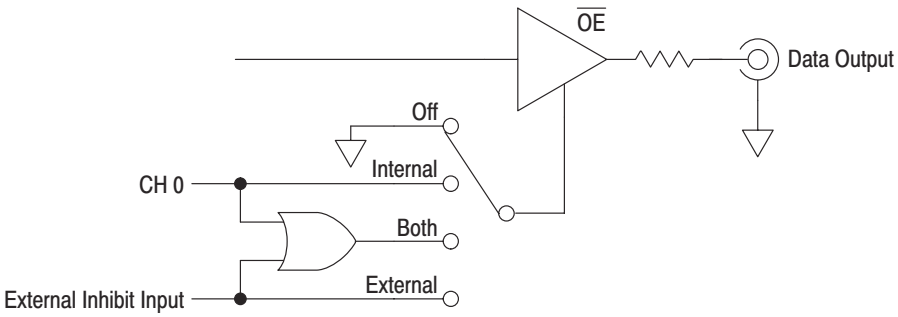


Figure 3-54: High-impedance control circuit

Level Condition Menu

This menu sets the channel output high and low voltage levels, and whether output is disabled in the output stopped state.

High Determines the output voltage when the data value is 1 (high level state). You can set the level within the range between –1.25 V and +3.50 V (into 50 Ω load). The difference between the high level and low level voltages must be between 0.25 V and 5 V. The displayed voltages are the voltages when the outputs are open.

Operation. Set the output high level

Bottom button	Popup menu	Side button
Level Condition		High (the high level setting)

Low Determines the output voltage when the data value is 0 (low level state). You can set the level within the range between –1.50 V and +3.25 V (into 50 Ω load). The difference between the low level and high level voltages must be between 0.25 V and 5 V. The displayed voltages are the voltages when the outputs are open.

Operation. Set the output low level

Bottom button	Popup menu	Side button
Level Condition		Low (the low level setting)

Z on Stop Sets whether all outputs should be set to the high-impedance state or whether they should continue to output their current values when the output is stopped with the **START/STOP** button. When **Z on Stop** is set to **On**, the output is set to the high-impedance state.

Operation. Set the output impedance when output is stopped

Bottom button	Popup menu	Side button
Level Condition		Z on Stop (select On or Off)

Timing Condition Menu

This menu lets you set each channel's rise, fall, and delay timing parameters. Figure 3-55 shows the current rise and fall time settings of an example output channel. You can also see the same image in the SETUP menu. Highlighted lines indicate the pulse edges currently set. The three non-highlighted horizontal lines from the top indicate the highest, 0 and lowest voltage levels that can be set. The two non-highlighted vertical lines indicate the signal rising edge at left and falling edge at right.

If the pulse edges are positioned at the non-highlighted vertical lines, the positive delay is currently set to zero. If the pulse edges are positioned left of the non-highlighted lines, the output pattern data will be delayed.

You can adjust the rise and fall times within this range indicated by two non-highlighted slope lines or set to FAST. When you try to set a rise or fall time out of the valid range, the display flashes the word **Rise** or **Fall** beneath the menu pulse image.

The range varies depending on the pulse amplitude. See Figure A-1 on page A-4 for the relationship between range and pulse amplitude and the value represented by FAST.

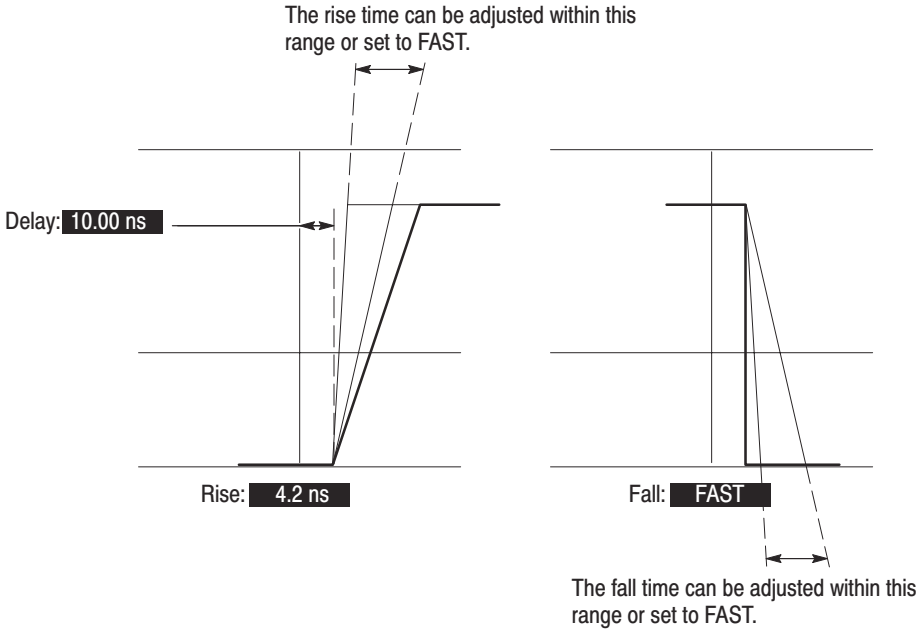


Figure 3-55: Example rise, fall, and delay parameters

Rise

Operation. Set the rise time

Bottom button	Popup menu	Side button
Timing Condition		
Select the channel for which the rise time is to be set using the knob.		
		Rise
Turn the knob to set a rise time. When you want to set the rise time to FAST enter 0 from the front panel keyboard.		

Fall

Operation. Set the fall time

Bottom button	Popup menu	Side button
Timing Condition		
Select the channel for which the rise time is to be set using the knob.		
		Fall
Turn the knob to set a rise time. When you want to set the rise time to FAST enter 0 from the front panel keyboard.		

Delay The delay can be adjusted set in the range –5.0 ns to 18.0 ns in 0.02 ns steps for each output.

Operation. Set the output delay

Bottom button	Popup menu	Side button
Timing Condition		
Select the channel for which the rise time is to be set using the knob.		
		Delay (the delay setting)

Run Mode Menu

This menu sets the run mode used to output pattern data, and sets the pattern data output update method used when data is changed.

Operation. Set the run mode

Bottom button	Popup menu	Side button
Run Mode		Select the run mode (Repeat, Single, Step, or Enhanced)

Repeat Pattern data is iteratively output. When no sequence is defined, all of the pattern data is output iteratively as a single pattern as shown in Figure 3-56. If a sequence is defined, the sequence ordering and repeat (**Repeat Count**) functions are applied. The extended sequence functions (trigger input, event jump, etc.) are ignored as shown in Figure 3-57.

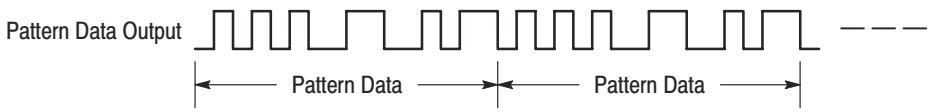


Figure 3-56: Repeat Mode pattern data output (when no sequence is defined)

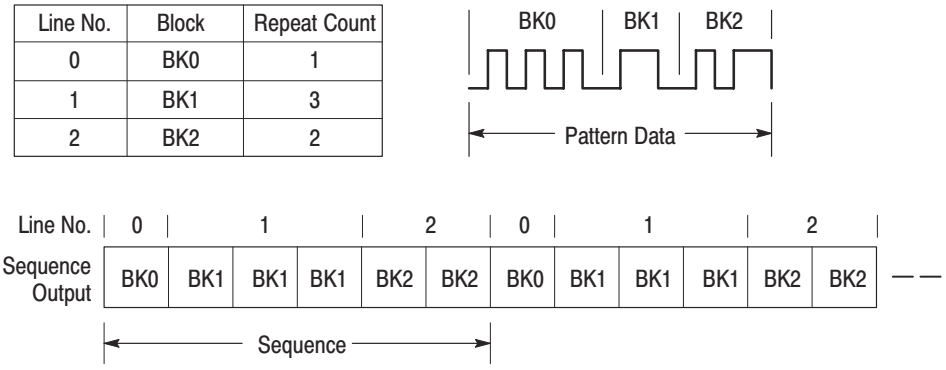


Figure 3-57: Repeat Mode pattern data output (when a sequence is defined)

Single Pattern data is output only once when a trigger input is received. A trigger signal is received either when the front panel **FORCE TRIGGER** button is pressed or when an external trigger signal is input to the **TRIGGER INPUT** connector.

When no sequence is defined, all of the pattern data is output as a single waveform as shown in Figure 3-58. If a sequence is defined, the sequence ordering and repeat (**Repeat Count**) functions are applied as shown in Figure 3-59. The extended sequence functions (trigger input, event jump, etc.) are ignored.

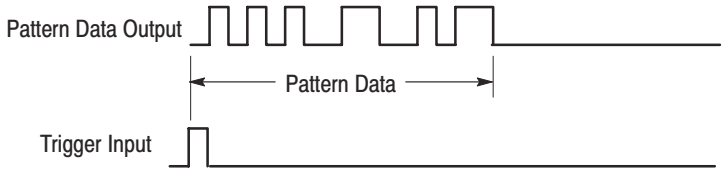


Figure 3-58: Single Mode pattern data output (when no sequence is defined)

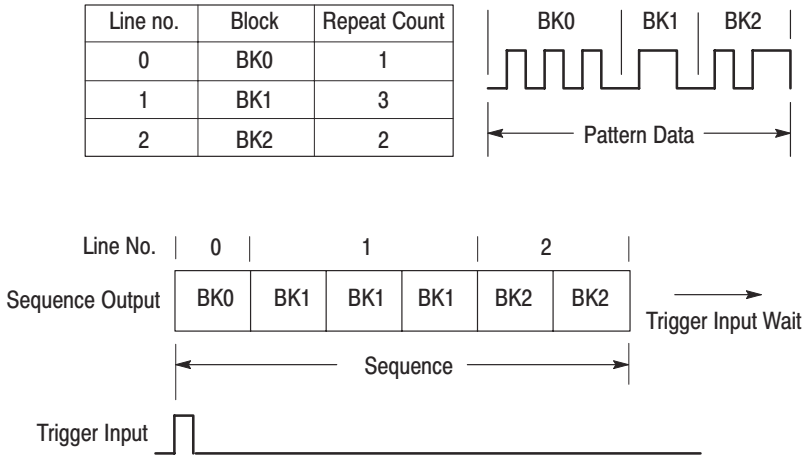


Figure 3-59: Single Mode pattern data output (when a sequence is defined)

Step Pattern data is output not according to the internal clock, but rather according to a clock signal generated manually with the **STEP/EVENT** button. Pattern data is output using the method used by the **Repeat** item.

Enhanced Pattern data is output as defined by the sequence. The extended sequence functions (trigger input, event jump, etc.) are valid during this output. The **Repeat Count** item setting is used for sequences for which the repeat count is not set to **Infinite**. Figure 3-60 shows an example of an enhanced mode sequence. Also refer to the description of the **EDIT** menu **Make Sequence** menu on page 3-55.

Line No.	Block	Repeat Count	Trigger Input (Trig Wait)	Event Jump
0	BK0	1	On	
1	BK1	Infinite		2
2	BK2	2		
3	BK3	2	On	
4	BK4	5		0

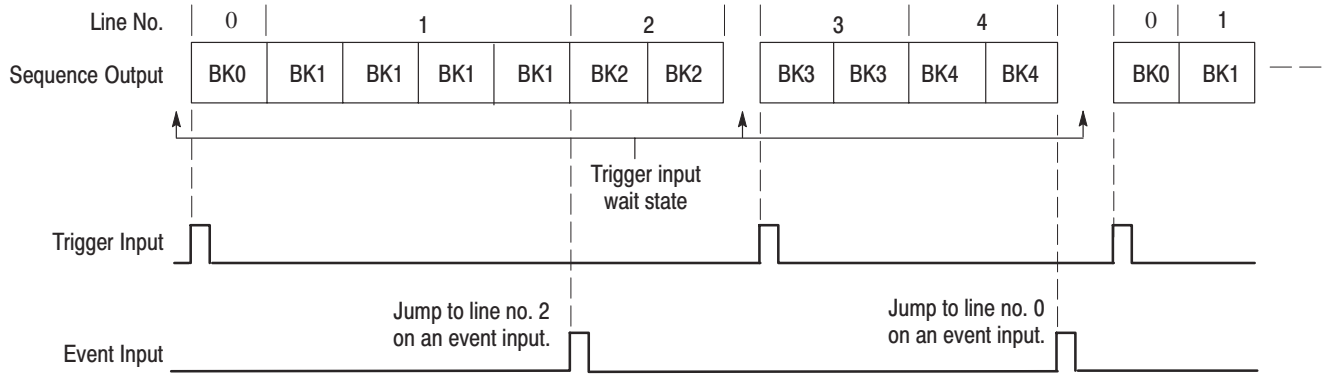


Figure 3-60: Enhanced Mode sequence output

Update

Sets the update method for rewriting data to the output when pattern data, the sequence, or other items are changed. Select **Auto** or **Manual**.

Auto. Rewrites the output data with new data immediately at the point when any change occurs to the pattern data. The **START/STOP** button LED indicator blinks rapidly during data update.

Manual. The output data is not immediately rewritten when the pattern data is changed. When the displayed data and the output data differ, the **START/STOP** button's LED indicator blinks slowly. To rewrite the pattern data, stop data output temporarily by pressing the **START/STOP** button, and then restart output by pressing the **START/STOP** button once again. Also note that changed pattern data is also written when the run mode changes.

Operation. Set the data update method

Bottom button	Popup menu	Side button
Run Mode		Update (Select Auto or Manual)

Trigger Menu

This menu sets the trigger settings. Figure 3-61 shows the setting selections.

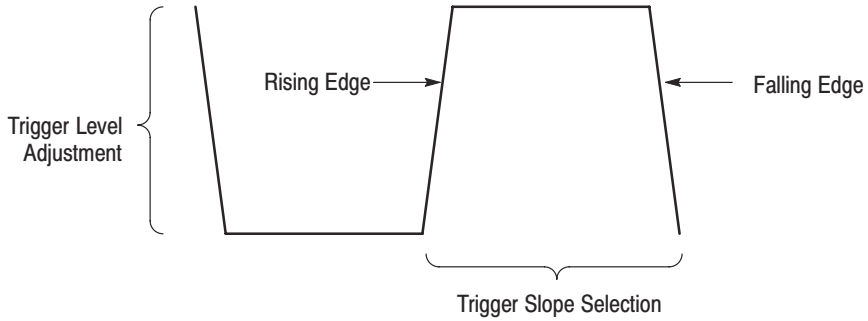


Figure 3-61: Trigger slope and level control

Slope Sets whether a trigger is recognized on either a rising or falling edge of the signal applied to the trigger input.

Positive: Rising edge
Negative: Falling edge

Operation. Set the trigger slope

Bottom button	Popup menu	Side button
Trigger		Slope (Select Positive or Negative)

Level Sets the threshold voltage for detecting a trigger. The value can be set from –5 V to +5 V in 0.1 V steps.

Operation. Set the trigger level

Bottom button	Popup menu	Side button
Trigger		Level (Set the trigger level.)

Impedance

Sets the trigger input connection impedance. An impedance of either **50 Ω** or **1 kΩ** can be set.

Operation. Set the trigger input impedance

Bottom button	Popup menu	Side button
Trigger		Impedance (Select 50 Ω or 1 kΩ)

Source

Selects internal (**Int**) or external (**Ext**) as a trigger source. When **Int** is selected, the signal generated from the internal trigger generator is used. In this case, the trigger signal can be generated repeatedly at a certain interval specified with the **Interval** menu item. When **Ext** is selected, the trigger signal connected to the **TRIGGER INPUT** connector on the front panel is used.

Operation. Select a trigger source

Bottom button	Popup menu	Side button
Trigger		Source (Select Int or Ext)

***NOTE**. Regardless of the trigger source selection, pressing the **FORCE TRIGGER** on the front panel causes to creat a trigger event.*

Interval

When the internal trigger source is selected, this parameter sets the trigger generator so as to repeatedly generate the trigger signal at a cetain interval. To use, set the trigger interval to On and then set the interval period.

When the trigger source is set to internal and the trigger interval state is set to Off, a trigger signal is not generated except by pressing the **FORCE TRIGGER** button on the front panel.

Operation. Set the trigger interval to on or off, and trigger interval.

Bottom button	Popup menu	Side button
Trigger		Interval
		State (Select On or Off)
		Time (Set the interval time)

Clock Menu

Determines the reference clock (and clock rate) used when pattern data is output.

Source

Determines whether the internal clock (**Int**) or an external input clock (**Ext**) is used as the reference clock.

Operation. Set the clock source

Bottom button	Popup menu	Side button
Clock		Source (Select Int or Ext)

Int FREQ

Sets the internal clock clock frequency. The frequency can be set in the range of 100 m Hz to 409.6 MHz. When **Source** is set to **Int**, the time axis resolution used for the display of pattern data will be the reciprocal of this setting.

Operation. Set the internal clock frequency

Bottom button	Popup menu	Side button
Clock		Int FREQ (Set the frequency)

Ext FREQ

Input a clock clock frequency to the external clock input. The frequency can be set in the range 100 m Hz to 409.6 MHz. When **Source** is set to **Ext**, the time axis resolution used for the display of pattern data will be the reciprocal of this setting.

Operation. Input an external clock frequency

Bottom button	Popup menu	Side button
Clock		Ext FREQ (Set the frequency)

PLL Sets whether or not the PLL (phase locked loop) circuit is used for internal clock frequency control. When this setting is **On** (PLL circuit used), the instrument can provide a clock with a high frequency precision. When **Off**, the instrument can provide a clock synchronized to an external trigger input. The off state eliminates jitter due to differences in the relative timing of the clock and the trigger signal.

Operation. Set up the PLL circuit

Bottom button	Popup menu	Side button
Clock		PLL (Select On or Off)

Application Menu

There are no items in this menu in the current version of the firmware.

Utility Menu

The bottom menus for the **UTILITY** menu includes the **Mass Memory**, **Cal**, **Display/Hardcopy**, **System**, **De-skew, Status**, and **Diag** items. When one of the bottom menu items is selected the related base menu is displayed. Parameters are selected using these base menus. Table 3-20 lists the functions of the **UTILITY** menu items and the pages where their descriptions appear.

Table 3-20: SETUP menu functions

Bottom	Base menu or Side menu		Function	Page
Mass Memory	Change Directory		Changing the current directory	3-86
	Make Directory		Creating directories	3-86
	Rename		Changing a file or directory name	3-86
	Copy or Delete	Copy	Copying files	3-86
		Delete	Deleting files	3-86
		Delete All	Deleting all files	3-87
	Special	Initialize Media	Formatting a floppy disk	3-88
		Catalog order	Setting the directory listing order	3-88
		Lock	Locking a file	3-88
Cal	Execute		Executing the clock calibration	3-89
Display/Hardcopy	Clear Message Area		Removing message displays	3-93
System	Reset to Factory		Restoring the factory settings	3-97
	Security Immediate		Erasing internal memory data	3-97
De-skew	Reset Skew		Setting a skew on each output channel	3-98
Status			Displaying the instrument information	3-99
Diag	Type	All	Selecting functional block or all block and executing the diagnostic test.	3-99
		CPU		
		Display		
		FPanel		
		Clock		
		Trig		
		SMenu		
		TPMenu		
	Execute			

Mass Memory Menu

The **Mass Memory** menu is used to access the contents of the floppy disk inserted in the instrument's floppy disk drive. This menu supports changing and creating directories, file copying and deleting, and floppy disk formatting.

Change Directory

Changes the current directory.

Operation. Change directory

Bottom button	Popup menu	Side button
Mass Memory		Change Directory
	Select the directory to switch to.	OK

Make Directory

Creates a sub-directory in the current directory.

Operation. Create a directory

Bottom button	Popup menu	Side button
Mass Memory		Make Directory
	Enter the name of the directory.	OK

Rename

Changes the name of a file or directory on the floppy disk. The file extension is not changed by this function.

Operation. Change a file or directory name

Bottom button	Popup menu	Side button
Mass Memory	Select the file or directory to be renamed.	Rename
		Clear String
	Enter the new file or directory name.	OK

Copy or Delete

Copies or deletes files on the floppy disk.

Sub Menu

Item	Function
Copy	Copies the selected file on the floppy disk, creating a new file.
Delete	Deletes the selected file from the floppy disk.

Sub Menu

Item	Function
Delete All	Deletes all the files in the current directory.
	Note: *If there is a sub-directory in the current directory, and that sub-directory is not empty, it will not be deleted. Also, locked files will not be deleted.*

Operation. Copy a file

Bottom button	Popup menu	Side button
Mass Memory		Copy or Delete
	Select the file to copy.	Copy
		OK
	Enter the name of the copy of the file.	OK

Operation. Delete a file

NOTE*. When deleting a file, the instrument asks for confirmation. Select either* ***OK*** *or* ***Cancel****.*

Bottom button	Popup menu	Side button
Mass Memory		Copy or Delete
	Select the file to delete.	Delete
		OK

Special

Supports formatting floppy disks, setting the file listing display order, and setting file locks.

Side Menu

Item	Function	
Initialize Media	Formats a floppy disk. Selecting this menu item pops up a list of floppy disk formats. Choose the format from the following list to format the floppy disk: IBM-PC 2HD PC9800 2HD J3100 2HD IBM-PC 2DD PC9800 2DD The volume label DG2030 is automatically assigned to the floppy disk by the formatting operation.	
Catalog Order	Specifies the order for display when listing a directory. Select the order from the following types:	
	Type	**Order**
	NAME1	ASCII order
	NAME2	Reverse ASCII order
	TIME1	In order created starting with oldest
	TIME2	In order created starting with newest
Lock	Changes the write protect attribute of the selected file. When the lock attribute is On, writing is prohibited, and when the lock attribute is Off, writing is allowed.	

Operation. Format a floppy disk

***NOTE**. All data on a disk is deleted by the formatting operation. Always check the contents of a disk before formatting it.*

Bottom button	Popup menu	Side button
Mass Memory		Special
		Initialize Media
	Select the format type.	OK
		OK

Operation. Set the directory listing order

Bottom button	Popup menu	Side button
Mass Memory		Special
		Catalog Order (Select the display type)

Operation. Lock a file

Bottom button	Popup menu	Side button
Mass Memory		Special
		Lock (Select On)

Cal Menu

Performs the calibration for the internal clock circuit. When the calibration finishes without error, "**Pass**" is displayed in the Status display area. If an error occurs, "**Fail**" is displayed and an error code appears in the Comment display area.

Operation. Lock a file

Bottom button	Popup menu	Side button
Cal		Execute

Table 3-21: Error Code

Error code	Error meaning	Failed component
8XX	CAL error	Clock board

The clock calibration is recommended to be performed in the following cases:

- After a 20-minute warm up period has been passed.
- When you need data pattern output with high precision frequency.
- When the ambient temperature is changed by about ±5°C since the previous clock calibration.

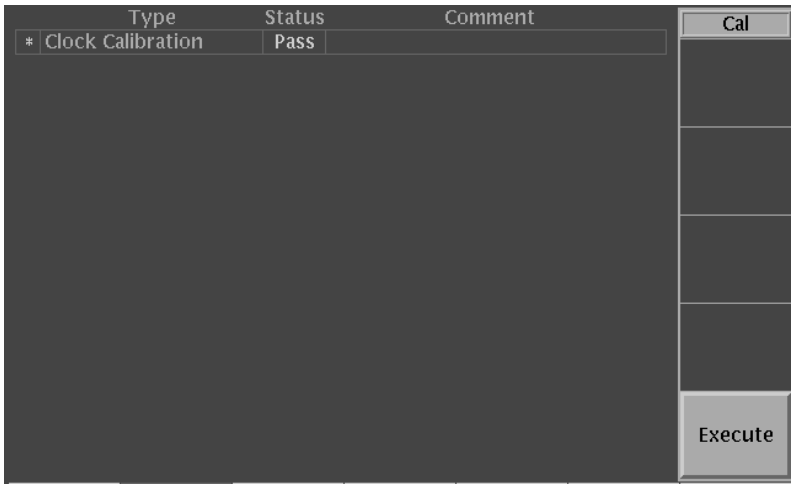


Figure 3-62: Cal menu

Display/Hardcopy Menu

This menu is used to set the display and hardcopy settings. Select the items to be changed using the up and down arrow buttons, and change the value or the item using the left and right arrow buttons or the general purpose knob.

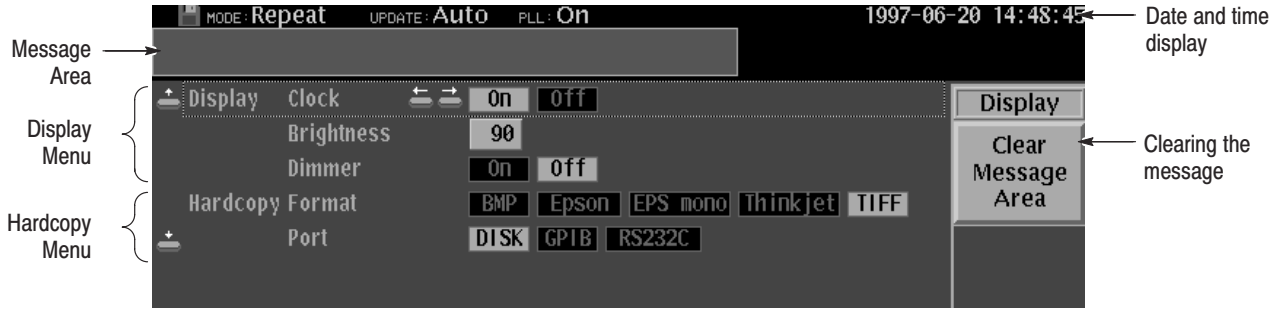


Figure 3-63: Display/hardcopy menu

Display

Sets the date and time display, adjusts the screen brightness, and sets the dimmer. The dimmer function automatically reduces the screen brightness if the DG2030 is left for 10 minutes without any controls being used.

Base menu

Item	Function
Clock	The date and time are displayed at the upper right of the screen when this setting is On.
Brightness	Adjusts the screen brightness. The value can be set in the range 0 to 100, with 100 being the maximum brightness. The default value is 70.
Dimmer	When set to On, the screen brightness is reduced if about 10 minutes elapses without any front panel control being used. The screen returns to its original brightness when any key is pressed.

Operation. Display the date and time

Bottom button	Popup menu	Side button
Display/Hardcopy	Select Display Clock with the up and down arrow buttons.	
	Select On with the left and right arrow buttons.	

Operation. Adjust the screen brightness

Bottom button	Popup menu	Side button
Display/Hardcopy	Select Display Brightness with the up and down arrow buttons.	
	Adjust the brightness.	

Operation. Set the dimmer

Bottom button	Popup menu	Side button
Display/Hardcopy	Select Display Dimmer with the up and down arrow buttons.	
	Select On with the left and right arrow buttons.	

Hardcopy

Sets the screen hard-copy data format settings, and sets the hard-copy output port. For connecting the printer to the GPIB or RS-232-C port, also refer to the System menu explained next. When you select Disk as a hardcopy port, you can capture and save a screen image to a file in a specific format.

Base menu

<table>
<tr><th>Item</th><th colspan="3">Function</th></tr>
<tr><td rowspan="7">Format</td><td colspan="3">Sets the screen hard-copy data format. The following are the menu options and the formats they specify.</td></tr>
<tr><td>Menu item</td><td colspan="2">Format</td></tr>
<tr><td>BMP</td><td colspan="2">Windows BMP</td></tr>
<tr><td>Epson</td><td colspan="2">Epson ESC-P</td></tr>
<tr><td>EPS mono</td><td colspan="2">Encapsulated Postscript</td></tr>
<tr><td>Thinkjet</td><td colspan="2">HP Thinkjet</td></tr>
<tr><td>TIFF</td><td colspan="2">TIFF</td></tr>
<tr><td rowspan="11">Port</td><td colspan="3">Sets the device for screen hard-copy data output.</td></tr>
<tr><td>Menu item</td><td colspan="2">Device</td></tr>
<tr><td>DISK</td><td colspan="2">Floppy disk</td></tr>
<tr><td>GPIB</td><td colspan="2">GPIB</td></tr>
<tr><td>RS232C</td><td colspan="2">Serial port</td></tr>
<tr><td colspan="3">When hard-copy output is to the disk, a file name with the format HC_XXX.YYY is used. Here, XXX is a serial number that is started from 000, and YYY is an extension that depends on the format used. XXX is chosen so as not to overwrite existing data. The table below lists the correspondence between formats and extensions.</td></tr>
<tr><td>Menu item</td><td>Format</td><td>Extension</td></tr>
<tr><td>BMP</td><td>Windows BMP</td><td>BMP</td></tr>
<tr><td>Epson</td><td>Epson ESC-P</td><td>ESC</td></tr>
<tr><td>EPS mono</td><td>Encapsulated Postscript</td><td>EPS</td></tr>
<tr><td>Thinkjet</td><td>HP Thinkjet</td><td>TJ</td></tr>
<tr><td>TIFF</td><td>TIFF</td><td>TIF</td></tr>
</table>

Operation. Set the hard copy format

Bottom button	Popup menu	Side button
Display/Hardcopy	Select Hardcopy Format with the up and down arrow buttons.	
	Select the format with the left and right arrow buttons.	

Operation. Select hardcopy output port

Bottom button	Popup menu	Side button
Display/Hardcopy	Select Hardcopy Port with the up and down arrow buttons.	
	Select the port with the left and right arrow buttons.	

Clear Message Area

Clears the message displayed in the message area.

Operation. Remove message displays

Bottom button	Popup menu	Side button
Display/Hardcopy		Clear Message Area

System Menu

This menu sets the instrument date, time, and the GPIB/serial port settings. The GPIB and serial ports can be used for remote control and screen hardcopy. Select the items to be changed using the up and down arrow buttons, and change the value or the selection using the left and right arrow buttons or the general purpose knob.

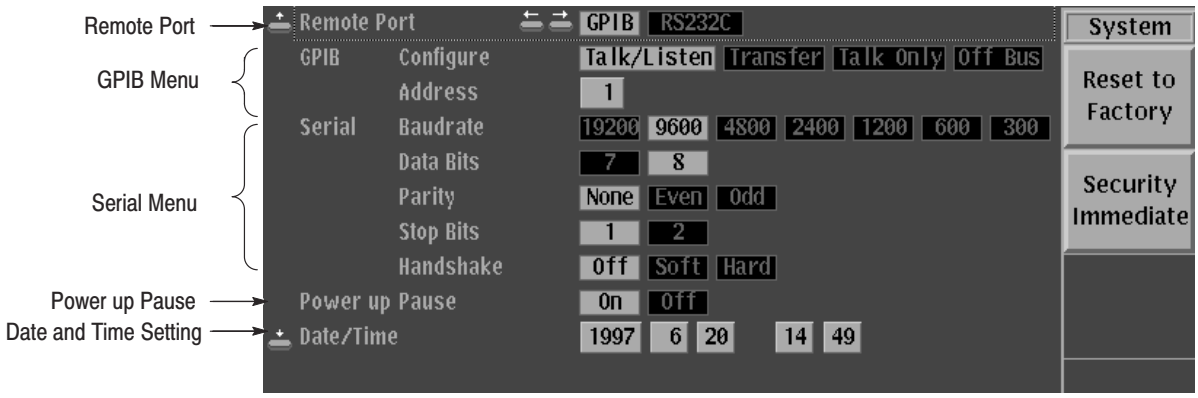


Figure 3-64: System menu

Remote Port

Set the port used for external remote control. Either the **GPIB** or the **RS232C** can be selected.

Operation. Remote port setup

Bottom button	Popup menu	Side button
System	Select Remote Port with the up and down arrow buttons.	
	Select the port with the left and right arrow buttons.	

GPIB

Sets the GPIB operating mode and address of the DG2030 for remote control or hardcopy.

Base Menu

Item	Function	
Configure	Sets the GPIB operating mode.	
	Operating Mode	**Function**
	Talk/Listen	Normal remote control
	Talk Only	Used for hard-copy output.
	Off Bus	The connection between the instrument and the bus is set to the disconnected state.
Address	Sets the instrument's GPIB address. The address can be set to a value between 0 and 30.	

Operation. Set the GPIB operating mode

Bottom button	Popup menu	Side button
System	Select GPIB Configure with the up and down arrow buttons.	
	Select the operating mode with the left and right arrow buttons.	

Operation. Set the GPIB address

Bottom button	Popup menu	Side button
System	Select GPIB Address with the up and down arrow buttons.	
	Select the address with the general purpose knob.	

Serial

Sets the baud rate, data length for transmitted data, parity, number of stop bit, and flow control method for the serial port. These parameters are set to match the settings of the connected external controller for remote control or printer for hardcopy.

Base Menu

Item	Function
Baudrate	Sets the transmission rate for the serial port. A transmission rate of 300, 600, 1200, 2400, 4800, 9600, or 19200 can be set.
Data Bits	Sets the data length for the transmitted data. A data length of 7 or 8 bits can be set.
Parity	Sets the kind of parity bit attached to transmitted data. The parity can be set to None, Even, or Odd.
Stop Bits	Sets the number of stop bits. 1 or 2 stop bits can be set.
Handshake	Sets the flow control method. Either Off, Soft, or Hard can be set for the flow control.

Operation. Set the serial interface parameters

Bottom button	Popup menu	Side button
System	Select the Serial parameter with the up and down arrow buttons.	
	Select the item with the left and right arrow buttons.	

Power up Pause

Sets whether or not the instrument should wait for key input before starting operation in the event a diagnostics error was detected at start up. This setting is useful in cases where, for example, you do not want the system waiting for key input.

Operation. Set the power-on pause

Bottom button	Popup menu	Side button
System	Select Power up Pause with the up and down arrow buttons.	
	Select On with the left and right arrow buttons.	

Date/Time

Sets the internal clock date and time.

Operation. Set the date and time

Bottom button	Popup menu	Side button
System	Select Date/Time with the up and down arrow buttons.	
	Select the parameter to change with the left and right arrow buttons.	
	Set the date and time with the general purpose knob.	

Reset to Factory

Resets the instrument settings to the default factory settings. The instrument internal memory is not cleared by resetting to the factory settings. See Appendix C for a table listing the instrument factory settings

Operation. Restore the factory settings

Bottom button	Popup menu	Side button
System		Reset to Factory
		OK

Security Immediate

Erases the instrument's internal memory data. At the same time, the instrument is reset to the factory settings state.

Operation. Delete memory data

Bottom button	Popup menu	Side button
System		Security Immediate
		OK

De-skew Menu

Sets or reset the skew for each output channel. The skew can be set within the range from –1.0 ns to +1.0 ns. See Figure 3-65 for the popup menu.

Figure 3-65: De-skew menu

Operation. Set the skew

Bottom button	Popup menu	Side button
De-skew	Select a output channel with up and down arrow buttons.	
	Set the skew with the knob.	

Operation. Reset the skew

Bottom button	Popup menu	Side button
De-skew	Select a output channel with up and down arrow buttons.	Reset Skew

Status Display

Displays the instrument's model number, the firmware version, the instrument's configuration, and other information. See Figure 3-66.

Figure 3-66: Status display

Diag Menu

Tests the instrument's internal hardware. Diagnostics can be run as individual tests, or all tests can be run in one operation. If the diagnostics complete with no errors, "**Pass**" is displayed in the **Status** display area. If an error occurs, "**Fail**" is displayed. An error code is displayed in the **Comment** display area if a diagnostic test fails. See Figure 3-67.

***NOTE**. Contact your Tektronix sales representative if any errors occur.*

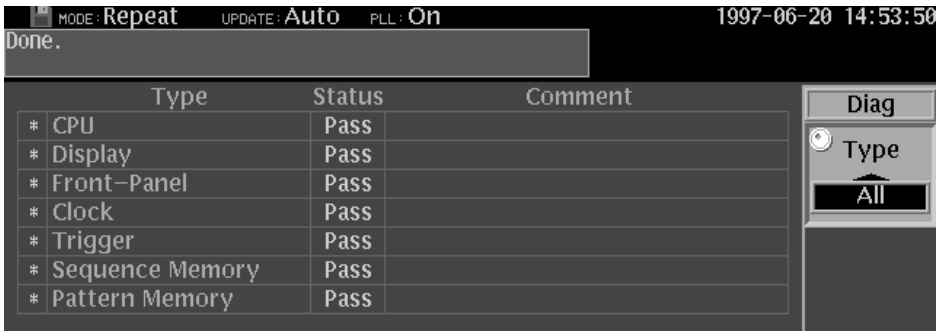


Figure 3-67: Diag menu

Table 3-22 lists the error codes, their meaning, and failure board for the error code. See the *DG2030 Service Manual* for detailed descriptions of the error codes.

Table 3-22: Error Code

Error code	Description	Failed component
1XX	CPU diagnostics error	A6 CPU board
2XX	Display diagnostics error	A6 CPU board
3XX	Front panel diagnostics error	A12 Key board
4XX	Clock diagnostics / calibration error	A30 Clock board
5XX	Trigger diagnostics / calibration error	A30 Clock board
6XX	Sequence memory error	A50 PG&Output board
7XX	Pattern memory diagnostics error	A50 PG&Output board

Side Menu

Item	Function
Type	Selects the diagnostics test. Either individual items or all tests (All) can be selected. An asterisk is displayed next to selected items.
Execute	Executes the diagnostic tests for the items marked with an asterisk.

Operation. Diagnostics

Bottom button	Popup menu	Side button
Diag		Type (Select a diagnostic test or All with the general purpose knob.)
		Execute

Appendix A: Specifications

The DG2030 specifications are divided into three categories:

- Warranted characteristics. Warranted characteristics are described in terms of quantifiable performance limits which are guaranteed.
- Typical characteristics. Typical characteristics are described in terms of typical or average performance for the DG2030. The characteristics described herein are not absolutely guaranteed.
- Functionality. Functionality describes instrument capabilities.

Items marked with asterisk (*) are tested in the *Performance Verification* (Appendix B).

The certification and compliances for the DG2030 are also found at the end of this appendix.

Warranted Characteristics

This section describes the warranted characteristics of the DG2030. These can be divided into two categories: electrical characteristics and environmental characteristics.

Items marked with asterisk (*) are tested in the Performance Verification (Appendix B).

Performance Conditions

The electrical characteristics are valid under the following conditions:

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

Table A-1: Warranted electrical characteristics

Characteristics	Description	Performance test
Internal trigger generator		
Internal trigger rate		
Accuracy	±0.01 %	
Data and clock out		
*Output voltage		See page B-28.
Accuracy		
DC (data out)	(±3 % of setting) ± 50 mV (into 50 Ω)	
Amplitude (clock out)	(±5 % of setting) ± 50 mV (into 50 Ω)	
Maximum Output Current	± 100 mA	
*Rise/fall time (20 % to 80 %)		See page B-28.
Accuracy	(±10 % of setting) ±500 ps, within the variable range	
*Channel skew	< ±300 ps, reference to the clock out, at 10 MHz, 50 % duty and rise/fall times set to FAST.	See page B-33.
*Delay function		See page B-33.
Accuracy	(±3 % of setting) ±500 ps ±60 ps × | Ambient temperature (°C) − 25 |, At 10 MHz, 50 % duty, 1.5 V high, 0 V low, and rise/fall times set to FAST.	
Event input		
Minimum pulse width	≧ 100 ns	
Sensitivity	≧ 1.0 Vp-p	
Inhibit input		
Minimum pulse width	≧ 100 ns	
Sensitivity	≧ 1.0 Vp-p	

Table A-1: Warranted electrical characteristics (Cont.)

Characteristics	Description	Performance test
Trigger input		
Threshold		
Accuracy	±(5 % of setting) ±0.1 V	
Minimum pulse width	≧ 10 ns	
Sensitivity	≧ 1.0 Vp-p	
Impedance	50 Ω ±2 Ω 1 kΩ ±100 Ω	
Unacceptable time on resetting trigger	Minimum 100 ns	
External clock input		
Threshold level	+0.5 V	
Input low voltage range	–2 V to 0.3 V	
Input high voltage range	0.7 V to 2.0 V	
Input frequency	DC to 406.9 MHz	
Minimum pulse width	≧ 1.2 ns	
Sensitivity	≧ 0.5 Vp-p	
Maximum input level	≦ ±2 V	
AC line power		
Rating voltage	100-240 V AC	
Voltage range		
90-250 V AC	Input frequency range from 48.0 to 63.0 Hz	
90-127 V AC	Input frequency range from 48.0 to 440.0 Hz	
Maximum power	300 W	
Maximum current	4 A	

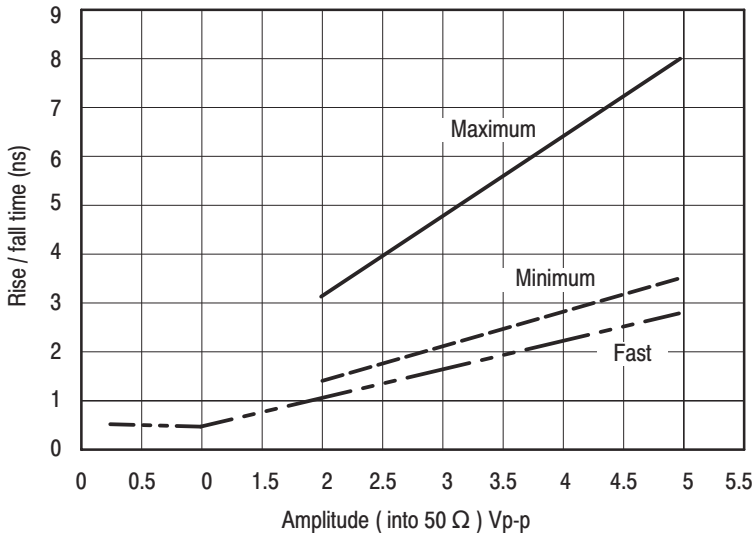


Figure A-1: Range of rise/fall times

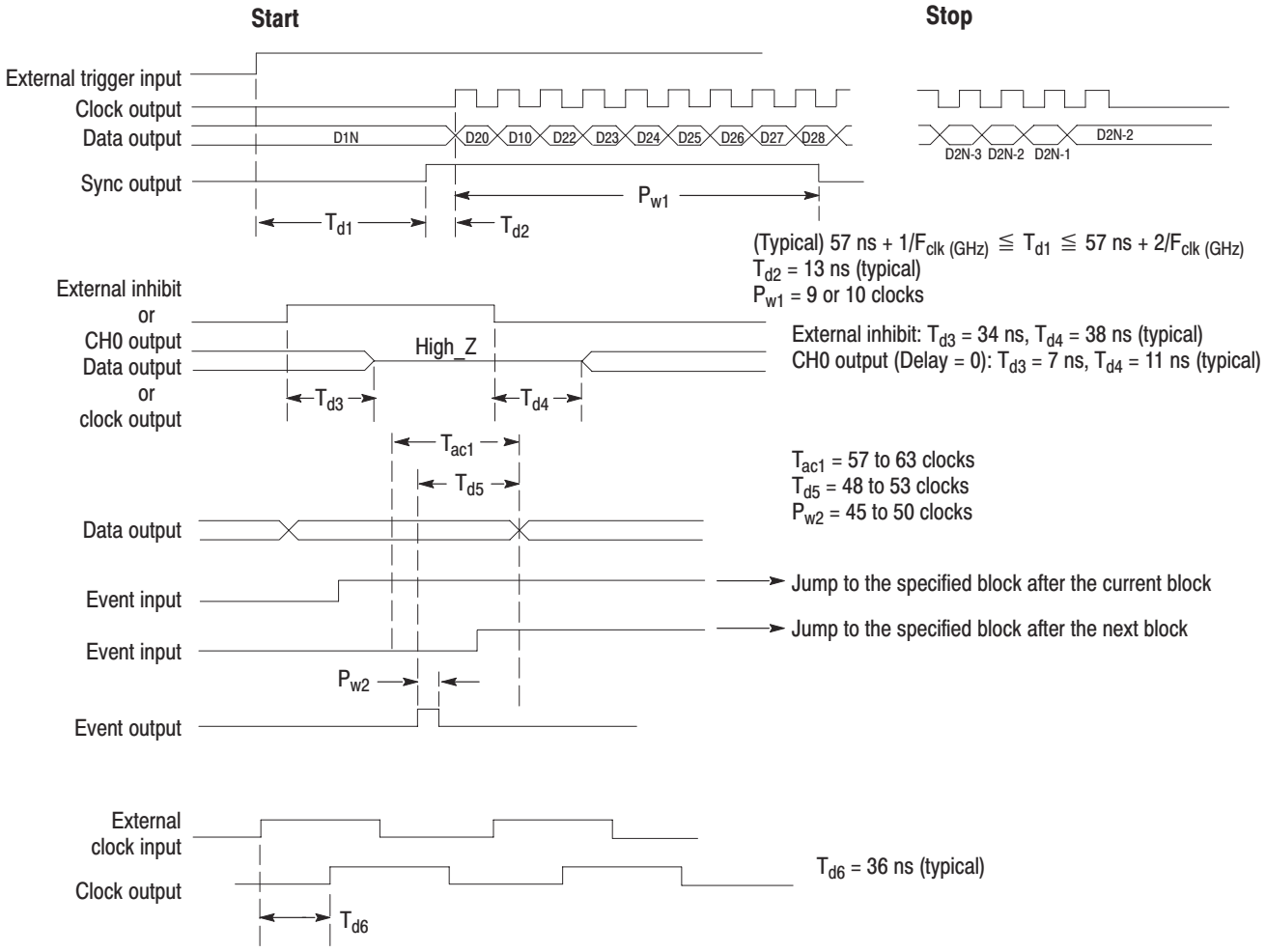


Figure A-2: Signal timing

Table A-2: Warranted environmental characteristics

Characteristics	Description
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	
Operating	To 4.5 km (15000 ft). Maximum operating temperature decreases 1 °C each 300 m above 1.5 km.
Non-operating	To 15 km (50000 ft).
Dynamics	
Vibration	
Operating	0.27 Grms, 5 to 500 Hz
Non-operating	2.28 Grms, 5 to 500 Hz
Shock	
Non operating	294 m/s^2 (30 G), half-sine, 11 ms duration. Three shocks per axis in each direction (18 shocks total)
Installation requirements	
Power consumption	300 watts max. Maximum line current is 4 A rms at 50 Hz
Dissipation (fully loaded)	90 V libe, with 5 % clipping
Surge current	≦ 9 A peak for less than 5 line cycles, at 25 °C, after product has been off for at least 30 s.
Cooling clearance	
Top clearance	2.5 cm (1 inch)
Side clearance	15 cm (6 inches)
Rear clearance	7.5 cm (3 inches)

Typical Characteristics

This section will describe the typical characteristics for the DG2030. These values represent typical or average performance and are not absolutely guaranteed.

Table A-3: Electrical characteristics (typical)

Characteristics	Description
Data and clock out	
Rise/fall time (20 % to 80 %)	
Value in FAST	500 ps, at 0.25 Vp-p to 1 Vp-p $<$ Value represented by FAST line from 2 Vp-p to 5 Vp-p in Figure A-2 on page A-5, at 1 Vp-p to 2 Vp-p $<$ 0.8 $\times$ Minimum value, at 2 Vp-p to 5 Vp-p
Aberration	
Overshoot	$\leqq$ 5 % at 3.5 Vp-p
Amplitude (clock out)	$\leqq$ 5 % at 3.5 Vp-p
Period jitter	Measured by TDS694C–1MHD with TDSJIT1 Refer to Table A-4.
Cycle to cycle jitter	Measured by TDS694C–1MHD with TDSJIT1 Refer to Table A-5.
Inhibit input	
Delay time to data to clock out	Refer to T_{d3} and T_{d4} in Figure A-2 on page A-5.
$\overline{\text{High Z}}$ to High Z	34 ns
High Z to $\overline{\text{High Z}}$	38 ns
Sync output	
Level	
V_{OH}	Approx. 5 V (into 1 MΩ) Approx. 2.5 V (into 50 Ω)
V_{OL}	Approx. 0 V (into both 1 MΩ and 50 Ω)
Delay time from external trigger input signal	Internal clock, PLL Off. Refer to T_{d1} in Figure A-2 on page A-5.
Trigger Input	57 ns + $1/F_{clk\ (GHz)}$ $\leqq$ T_{d1} $\leqq$ 57 ns + $2/F_{clk\ (GHz)}$
Delay time to clock out and data out	13 ns, Refer to T_{d2} in Figure A-2 on page A-5.
External clock input	
Delay time to clock out	36 ns. Refer to T_{d6} in Figure A-2 on page A-5.

Table A-4: Period JItter

Clock frequency	400 MHz (PLL ON)		200 MHz (PLL ON)	
Measurement	StdDev	Pk–Pk	StdDev	Pk–Pk
Clock output	6.0 ps	30 ps	6.0 ps	30 ps
CH0 output	50 ps	200 ps	15 ps	65 ps

Table A-5: Cycle to Cycle JItter

Clock frequency	400 MHz (PLL ON)		200 MHz (PLL ON)	
Measurement	StdDev	Pk–Pk	StdDev	Pk–Pk
Clock output	30 ps	200 ps	12 ps	60 ps
CH0 output	100 ps	340 ps	20 ps	90 ps

Nominal Traits

This section describes the general characteristics of the DG2030. These are divided into two main categories: Table A-6 Electrical Characteristics and Table A-7 Mechanical Characteristics.

Table A-6: Nominal traits - electrical characteristics

Characteristics	Description
Operation mode	
Repeat	Pattern data is repeatedly output. When a sequence is specified, patterns are repeated according to the sequence order. The extended sequence functions such as trigger wait, event jump, etc. are ignored in this mode.
Single	Pattern data is output only once. When a sequence is specified, a trigger signal causes to perform output according to the sequence order.
Step	Pattern data are output based on the clock, not specified by clock source, but generated by pressing the **STEP/EVENT** button on the front panel. This mode is the same as Repeat mode except for the clock.
Enhanced	Pattern data is output completely according to a sequence. The all extended sequence functions such as trigger wait, event jump, etc. are valid in this mode. This mode is same as Repeat mode except for the extended sequence functions.
Output pattern	
Pattern length	90 to 262144 points
Number of channels	Up to 4 for standard and 8 for option 01
Sequence	Maximum 4000 steps
Number of blocks	Maximum 256

Table A-6: Nominal traits - electrical characteristics (Cont.)

Characteristics	Description
Clock generator	
Internal clock	
Frequency	0.1 Hz to 409.6 MHz
Resolution	
PLL on	7 digits
PLL off	4 digits
Accuracy	
PLL on	±0.0001 %, 1 year after shipment from factory
PLL off	±3 %, 1 day after self calibration
Internal trigger generator	
Internal trigger rate	
Range	1.0 µs to 10.0 s
Resolution	3 digits, 0.1 µs min.
Data and clock out	
Connectors	CH0 to CH3, and clock out (BNC connectors at front panel) CH4 to CH7 (BNC connectors at rear panel)
Output impedance	50 Ω (typical)
Output voltage	
V_{OH}	–1.25 V to +3.50 V (into 50 Ω)
V_{OL}	–1.50 V to +3.25 V (into 50 Ω)
Resolution	5 mV (into 50 Ω)
Voltage swing ($V_{OH} - V_{OL}$)	0.25 V to 5.00 V (into 50 Ω) 0.5 V to 10 Vp-p (into 1 MΩ)
Rise/fall times	Rise and fall time can be varied when the amplitude is within the range from 2 Vp-p to 5 Vp-p into 50 Ω.
Variable range	The variable range varies depending on the amplitude. See Figure A-1 on page A-4. FAST can be set to rise and/or fall time in this instrument, which means output rising and/or falling edge(s) are/is the fastest.
De-skew	
Range	±1 ns
Resolution	10 ps
Delay function	
Delay channel	CH0, CH1, CH2, CH3, CH4, CH5, CH6, and CH7 (Referenced to clock out)
Delay time	–5 ns to +18 ns
Resolution	20 ps

Table A-6: Nominal traits - electrical characteristics (Cont.)

Characteristics	Description
Inhibit function	
Mode	
Off	Output is always enable.
Internal	Controlled by CH0 signal
External	Controlled by inhibit input signal
Both	Controlled by both CH0 signal and inhibit input signal
Event input	
Connector	BNC at rear panel
Threshold level	–5.0 V to +5.0 V, +1.4 V at default
Resolution	0.1 V
Input impedance	1 kΩ (typical)
Turning point for event jump	57 to 63 clocks before the next block. Refer to T_{ac1} in Figure A-2 on page A-5.
Maximum input voltage	±5 V
Polarity	Positive (rising edge)
Event output	
Connector	BNC at rear panel
Level	
V_{hi}	Approx. 5 V into 1 MΩ Approx. 2.5 V into 50 Ω
V_{lo}	Approx. 0 V into both 1 MΩ and 50 Ω
Delay time	48 to 53 clocks before data output change. Refer to T_{d5} in Figure A-2 on page A-5.
Pulse width	45 to 50 clocks. Refer to P_{W2} in Figure A-2 on page A-5.
Impedance	50 Ω
Inhibit input	
Connector	BNC at rear panel
Threshold level	–5.0 V to +5.0 V, +1.4 V at default
Resolution	0.1 V
Input impedance	1 kΩ (typical)
Maximum input voltage	±5 V
Sync output	
Connector	BNC at rear panel
Pulse width	9 or 10 clocks. Refer to P_{W1} in Figure A-2 on page A-5.
Impedance	50 Ω (typical)

Table A-6: Nominal traits - electrical characteristics (Cont.)

Characteristics	Description
Trigger input	
Connector	BNC at front panel
Threshold level	–5.0 V to +5.0 V, +1.4 V at default
Resolution	0.1 V
Impedance	50 Ω or 1 kΩ
Polarity	Positive or Negative
External clock input	
Connector	BNC at rear panel
Impedance	50 Ω terminated to 0.5 V
Display	
Display area	Width: 13.2 cm (5.2 inches) Height: 9.9 cm (3.9 inches)
Resolution	Horizontal: 640 pixels Vertical: 480 pixels
AC line power	
Fuse rating	6A FAST, 250 V, UL 198G (3AG) 5A (T), 250 V, IEC 127

Table A-7: Nominal traits - mechanical characteristics

Characteristics	Description
Net weight	
Standard	10.3 kg (22.7 lb)
Dimensions	
Height	164 mm (6.4 inches) including feet
Width	362 mm (14.3 inches) including handle
Length	491 mm (19.25 inches) including front cover 576 mm (22.2 inches) with handle extended

Certification and Compliances

The certification and compliances for the DG2030 are listed in Table A-8.

Table A-8: Certifications and compliances

Category	Standards or description
EC Declaration of Conformity – EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities: EMC Directive 89/336/EEC: EN 55011 — Class A Radiated and Conducted Emissions EN 50081-1 Emissions: EN61000-3-2 — AC Power Line Harmonic Emissions EN 50082-1 Immunity: EN61000-4-2 — Electrostatic Discharge Immunity EN61000-4-3 — RF Electromagnetic Field Immunity EN61000-4-4 — Electrical Fast Transient/Burst Immunity EN61000-4-11 — Voltage Dips and Interruptions Immunity
Australian/New Zealand declaration of Conformity - EMC	Complies with EMC provision of Radio–communications Act per the following standard: AS/NZS 2064.1/2 — Industrial, Scientific, and Medical Equipment: 1992
EC Declaration of Conformity – Low Voltage	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/A1:1992 — Safety requirements for electrical equipment for measurement, control and laboratory use.
Approvals	Complies with the following safety standards: UL3111–1, First Edition — Standard for electrical measuring and test equipment. CAN/CSA C22.2 No.1010.1-92 — Safety requirements for electrical equipment for measurement, control and laboratory use.
Installation Category	CAT II
	Terminals on this product may have different installation (over–voltage) category designations. The installation categories are: Category — Examples of products in this category CAT III — 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.

Table A-8: Certifications and compliances (cont.)

Category	Standards or description
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. 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.
Conditions of Approval	Safety Certifications/Compliances are made for the following conditions: Altitude (maximum operation): 2000 meters
IEC Characteristics	Equipment type: Test and Measuring Installation Category II (as defined in IEC 61010–1, Annex J) Pollution Degree 2 (as defined in IEC 61010–1) Safety Class I (as defined in IEC 61010–1, Annex H)

Appendix B: Performance Verification

This section describes the operation tests for the DG2030 data generator, and the procedures for those tests. The operation tests can be divided into two categories.

- Self Tests.

  The DG2030 incorporates a diagnostic system that performs comprehensive instrument testing. This system confirms that the DG2030 is operating correctly. The self tests execute quickly and require no special equipment during execution.

- Performance Tests.

  These tests confirm the operation of the items that are marked with an asterisk (*) in the guaranteed items in the operating specifications listed in Appendix A, *Performance Characteristics*. The equipment listed in Table B-2 is required to perform these performance tests.

Before Running the Operation Tests

Perform the following before running the Operation Tests.

Warm up

A 20 minute warm up period is required prior to running the operation tests.

Calibration

The clock calibration must be performed after the warm up period has been passed. The calibration must be made during operations at least when the ambient temperature has been changed by ±5 °C from previous calibration.

To perform the clock calibration:

1. Select **UTILITY → Cal → Execute**.
2. Verify whether error have occurred or not in the screen.

File Loading

The performance check disk provided with the DG2030 includes the files listed in Table B-1. The specified file must be loaded into the DG2030 for each operation test item. These files include pattern data and setup information.

Table B-1: Performance check disk's file list

File name	Operation test
TP1CLK.PDA	Internal clock frequency
TP2EXCLK.PDA	External clock input
TP3PG.PDA	Sequence and digital output
TP5EV52.PDA	Event input
TP6INH.PDA	Inhibit function
TP7LVL.PDA	Data output voltage level
TP8PULSE.PDA	Clock output amplitude and delay time
TP9ABBE.PDA	Aberration

Use the following procedure to load the file required by a performance test into the instrument.

1. Insert the performance check disk into the DG2030's floppy disk drive.
2. Select **EDIT → File → Load Data & Setup**.
3. Select the required file using the general purpose knob.
4. Select **OK** from the sub menu.

Required Equipment

Table B-2 lists the equipment required for the performance tests.

Table B-2: Required equipment

Item	No.	Required precision	Recommended equipment
Frequency counter	1	Frequency range: 0.1 Hz to 400 MHz Precision: 7 digits or higher	ANRITSU MF 1603A
Digital multi–meter	1	DC voltage range: ±10 V Precision: 0.01 V	Tektronix DM2510
Performance check disk	1		Tektronix part no. 063-2922-XX (provided with the DG2030)
Oscilloscope	1	Bandwidth: 1 GHz or higher	Tektronix TDS784A
Function generator	1	Amplitude: 4 V, offset: 2 V (50 Ω termination), Frequency: 1 MHz or higher	Tektronix AFG2020
BNC cable	5	Impedance: 50 Ω Length: 24 inches	Tektronix part no. 012-1342-00
Precision 50 Ω termination	1	Impedance: 50 Ω (0.1 %)	Tektronix part no. 011-0129-00
BNC T dual input adapter	1		Tektronix part no. 103-0030-00
N-to-BNC adapter	1		Tektronix part no. 103-0045-00
BNC-dual-banana adapter	1		Tektronix part no. 103-0090-00

Test Procedure Notes

The following conventions are used in this section for describing the self tests and performance tests.

- The test items are described in the following order.
  - Characteristic tested
  - Required equipment
  - Connections
  - Test procedure
- The test procedure is presented in order starting with step 1, and progresses through the end of the procedure. Tables such as the one shown below appear in these steps. For these steps, press the buttons in the order shown in the table, either from left to right or from top to bottom, to select the required menu item. For pop up menus, use the general purpose knob to select items from the menu list. Operations such as operation 6 do not involve pressing the buttons shown in the row above, but rather are descriptions of operations to be performed. Figure B-1 shows the buttons used and the menu layout.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
Operation 1	Operation 2	Operation 3	Operation 4	Operation 5
Operation 6 (e.g., insert a disk in the disk drive.)				
			Operation 7	

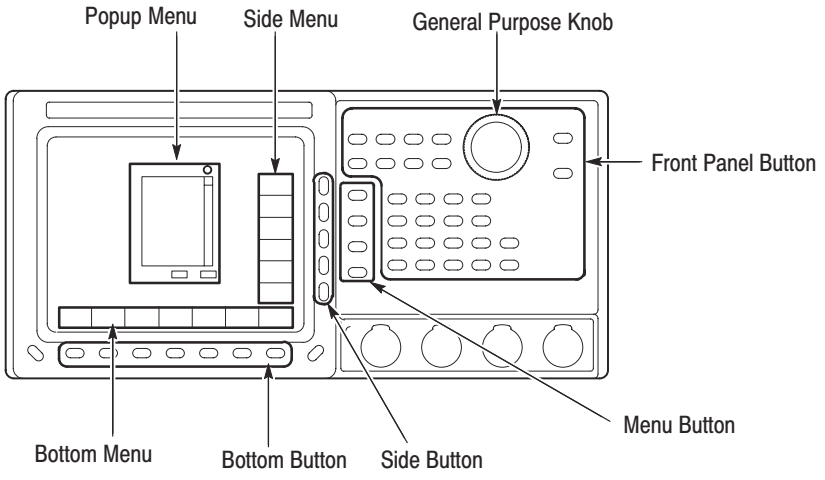


Figure B-1: Operating buttons and menu layout

Self Tests

Execute the DG2030 self tests and confirm that no errors occurred.

1. Press the required buttons in the following order. Selecting **All** from the **Type** side button causes the instrument to run the self-test on all test items.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
UTILITY	Diag		Type (Select All)	
			Execute	

2. Confirm that all self tests passed by checking the **Status** display area shown in Figure B-2.

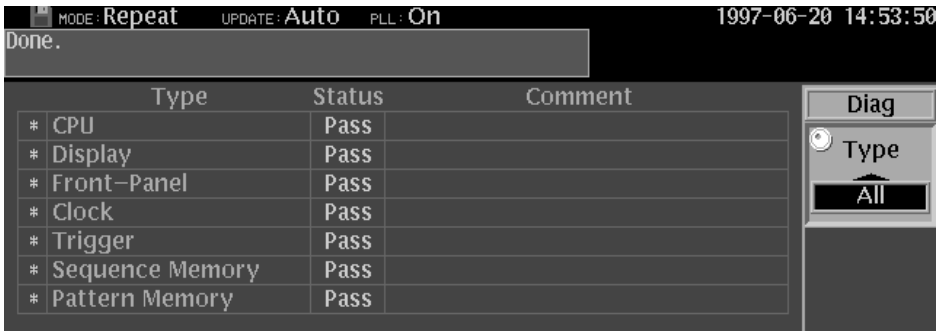


Figure B-2: Diagnostics menu

If **Fail** is listed in the **Status** display area, an error code will be displayed in the **Comment** column. See Table B-3 for the meanings of the error codes.

***NOTE**. Contact your Tektronix sales representative if an error occurs.*

Table B-3: Error codes

Error code	Error meaning	Failed component
1XX	CPU diagnostics error	A6 CPU board
2XX	Display diagnostics error	A6 CPU board
3XX	Front panel diagnostics error	A12 Key board
4XX	Clock diagnostics / calibration error	A30 Clock board
5XX	Trigger diagnostics / calibration error	A30 Clock board
6XX	Sequence memory error	A50 PG&Output board
7XX	Pattern memory diagnostics error	A50 PG&Output board

Performance Tests

The performance test for the DG2030 must be performed in the following order.

- Internal clock frequency
- External clock input
- Sequence & digital output
- Inhibit function
- Output level, amplitude, rise time and fall time accuracies
- Delay time accuracy

Internal Clock Frequency

This test confirms the frequency accuracy of the DG2030 internal clock.

With the PLL circuit on: Clock frequency ±0.0001 %

With the PLL circuit off: Clock frequency ±3 %

Equipment Required	Frequency counter
	BNC cable
	50 Ω termination
	N-to-BNC adapter
	Performance check disk

Connections. Connect the clock output from the DG2030 front panel to the frequency counter input (INPUT B) through the N-to-BNC adapter with the BNC cable.

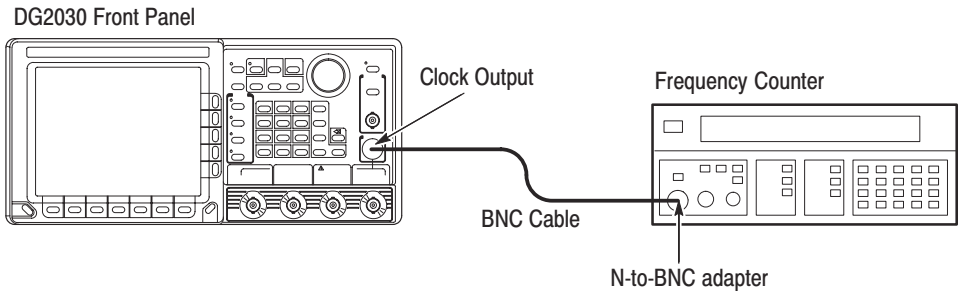


Figure B-3: Frequency measurement connections

Setup. Set the frequency counter to frequency measurement mode.

Characteristics Confirmation Procedure.

1. Load the **TP1CLK.PDA** test pattern file from the performance check disk. When the file is loaded, the DG2030 clock frequency will be set to 400 MHz internally and the PLL circuit will be turned on.

The following steps check the clock frequency accuracy with the PLL circuit on and the internal clock frequency set to 400 MHz.

2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Set the counter trigger to an appropriate value and confirm that the counter displays a frequency in the range 399.9996 to 400.0004 MHz.

The following steps check the clock frequency precision with the PLL circuit on and the internal clock frequency set to 200.1 MHz, 200 kHz and 100.0 mHz.

4. Press the following buttons to set the DG2030 clock frequency to 200.1 MHz.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Clock		Int FREQ	200.1 MHz/μs

5. Set the counter trigger to an appropriate value, and confirm that the counter displays a frequency in the range 200.0998 MHz to 200.1002 MHz.
6. Change the frequency counter input to INPUT A through the 50 Ω termination with the BNC cable.
7. Set the DG2030 clock frequency to 200 kHz.
8. Set the counter trigger to an appropriate value, and confirm that counter displays a frequency in the range 199.9998 kHz to 200.0002 kHz.
9. Set the DG2030 clock frequency to 100 mHz.
10. Set the frequency counter to period measurement mode.
11. Set the counter trigger to an appropriate value, and confirm that the counter displays a frequency in the range 99.9999 mHz to 100.0001 mHz.

The following steps check the clock frequency accuracy with the PLL circuit off and the internal clock frequency set to 400 MHz, 200 kHz and 100.0 mHz.

12. Press the following buttons to turn the PLL circuit off.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Clock		PLL (Set to Off)	

13. Set the internal clock frequency to 400 MHz, 200 kHz, and 100.0 mHz, and confirm that the frequencies and periods measured by the frequency counter fall within the ranges shown in Table B-4.

Table B-4: Internal clock frequency precision (PLL off)

Internal clock frequencies	Clock frequency ranges
400.0 MHz	388 MHz ~ 412 MHz
200.0 kHz	194 kHz ~ 206 kHz
100.0 mHz (10.0 s)	97 mHz ~ 103 mHz

14. Press the **START/STOP** button on the front panel to stop output (the button's LED goes off).

External Clock Input

This test confirms external clock input operation. Confirm that the clock signal is output from the CLOCK OUT connector when a square wave signal with a frequency of 1 MHz and an amplitude of 1 V (V_{IH} > 0.7 V, V_{IL} < 0.3 V) is input as an external clock signal.

Equipment Required	Oscilloscope
	Function generator
	Two BNC cables
	Performance check disk

Connections. Connect the clock output from the DG2030 front panel to the oscilloscope CH1 input with an BNC cable. Connect the function generator output to the DG2030 rear panel clock input with the other BNC cable.

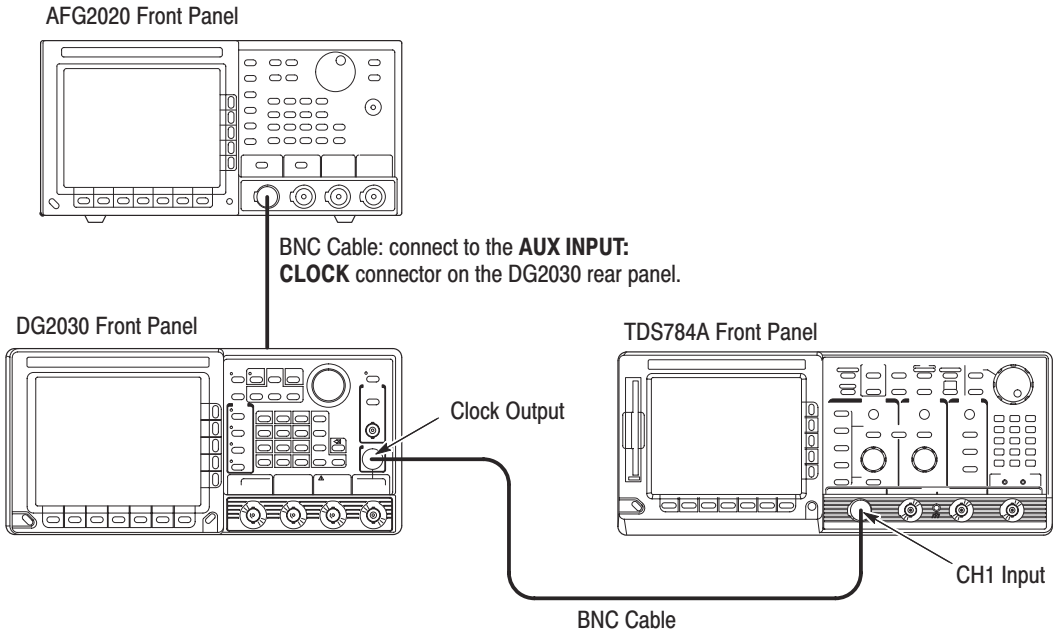


Figure B-4: External clock input connections

Setup.

- Oscilloscope

Displayed channel	CH1
Vertical axis	500 mV/div
Horizontal axis . . .	1 μs/div
Trigger mode	Auto
Trigger level	500 mV
Input coupling	DC
Input impedance . .	50 Ω

- Function generator

Waveform	Square wave
Frequency	1 MHz
Amplitude	1 V (50 Ω termination)
Offset	500 mV (50 Ω termination)

Characteristics Confirmation Procedure.

1. Load the **TP2EXCLK.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Confirm that the clock pulse waveform can be observed on the oscilloscope.
4. Press the **START/STOP** button on the front panel to stop output (the button's LED goes off).

Sequence & Digital Output

This test confirms that pattern data is output from the DG2030 output channel ports (CH0 through CH7) in various run modes.

Equipment Required	Oscilloscope
	Function generator
	Five BNC cables
	BNC T adapter
	Performance check disk

Connections. Connect the clock output from the DG2030 front panel to the oscilloscope CH1 input with an BNC cable. Connect the function generator output to the DG2030 rear panel event input with the other BNC cable.

Next, using the BNC cables, connect the CH0 signal output from the DG2030 to the oscilloscope CH2 input, the event output from the DG2030 rear panel to the oscilloscope CH3 input, and the sync output from the DG2030 rear panel to the oscilloscope CH4 input. See Figure B-5 for those connection

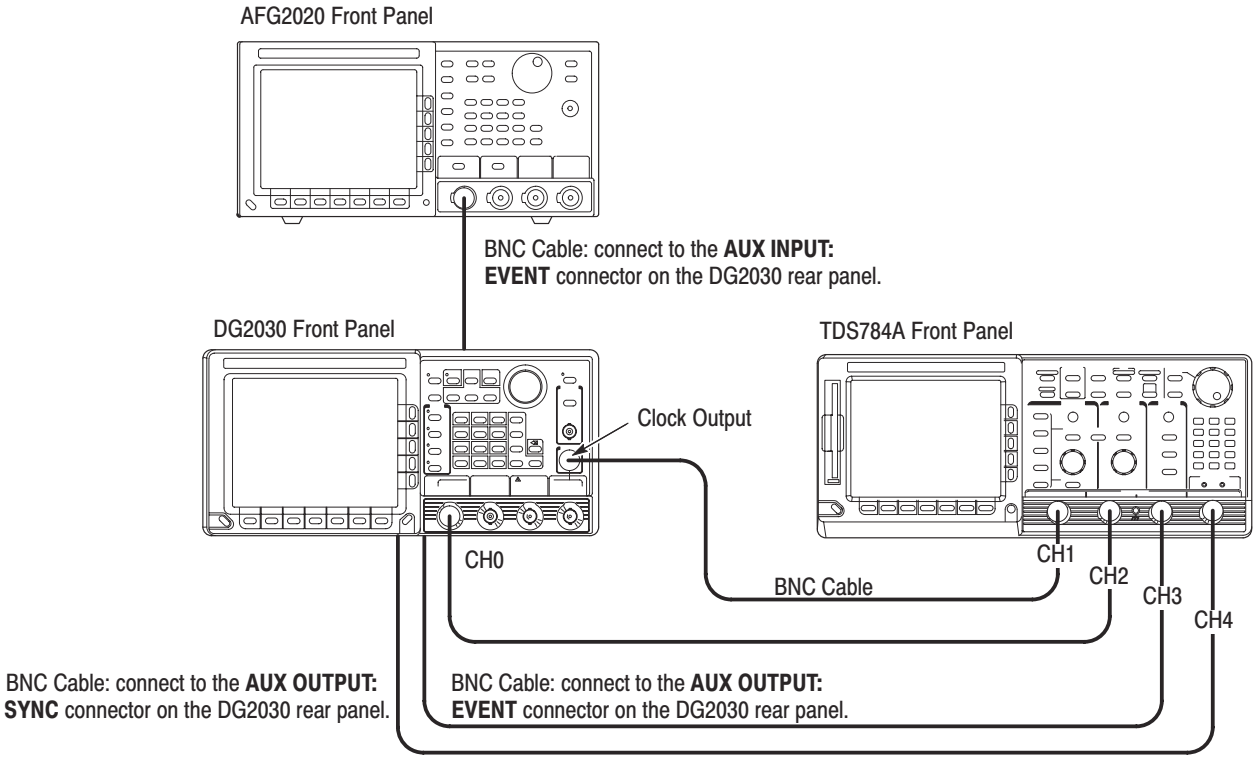


Figure B-5: Sequence & digital output connections #1

Setup.

- Oscilloscope

Displayed channel	CH1, CH2, CH3 and CH4
Vertical axis	1 V/div for CH1 and CH2
	5 V/div for CH3 and CH4
Horizontal axis . . .	400 ns/div
Record length	5000
Acquire mode	Peak Detect
	Single acquisition sequence (Stop After menu)
Trigger mode	Auto
Trigger level	2 V
Trigger source	CH4
Trigger position . .	3 %
Input coupling	DC
Input impedance . .	50 Ω for CH1 and CH2
	1 MΩ for CH3 and CH4

- Function generator

Waveform	Square wave
Frequency	500 kHz
Amplitude	1 V (50 Ω termination))
Offset	500 mV

Characteristics Confirmation Procedure.

1. Load the **TP3PG.PDA** test pattern file from the performance check disk.

The following steps check the pattern data output operation in Repeat run mode.

2. Press the following buttons to set the DG2030 run mode to **Repeat**.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Run Mode		Repeat	

3. Run the oscilloscope for acquisition.

4. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

5. Confirm that the data pattern shown in Figure B-6 appears on the oscilloscope.

6. Press the **START/STOP** button on the front panel to stop output (the button's LED goes off).

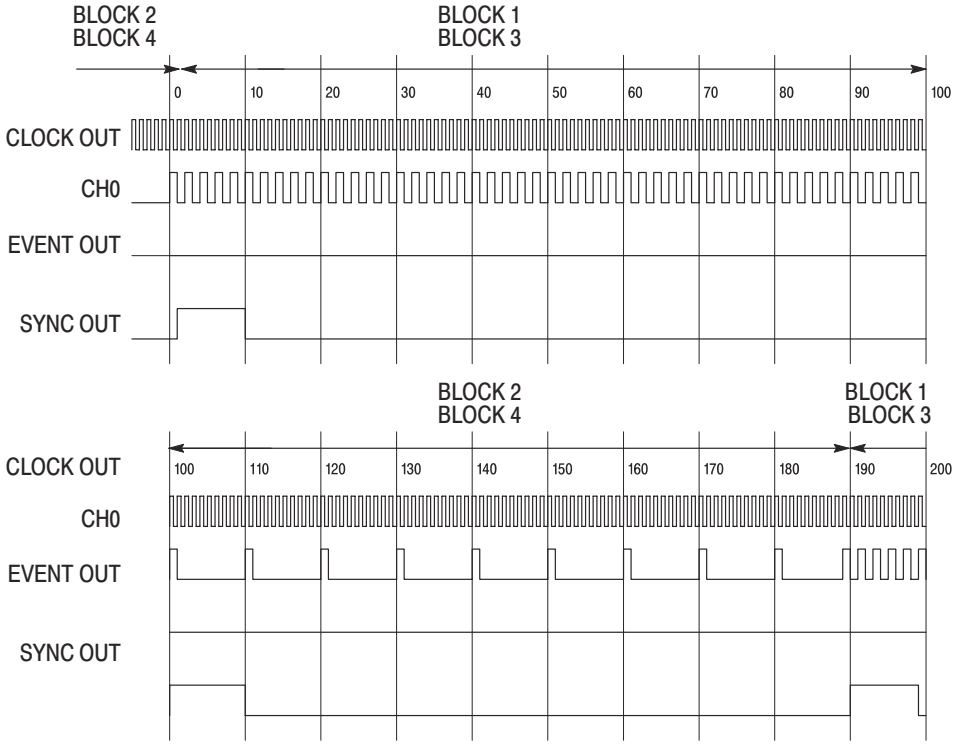


Figure B-6: Repeat mode timing chart

The following steps check the pattern data output operation in Single run mode.

7. Press the following buttons to set the DG2030 run mode to **Single**.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Run Mode		Single	

8. Run the oscilloscope so that the oscilloscope is waiting for a trigger event.

9. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

10. Confirm that the CH0 output data pattern as shown in Figure B-7 appears on the oscilloscope screen once every time the **FORCE TRIGGER** button on the DG2030 front panel is pressed.

11. Press the **START/STOP** button on the front panel to stop output (the button's LED goes off).

The following steps check the pattern data output operation in Step run mode.

12. Press the following buttons to set the DG2030 run mode to **Step**.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Run Mode		Step	

13. Cancel the single acquisition mode setting in the oscilloscope, and then start acquisition.

This can be made by selecting **SHIFT + ACQUIRE (front panel → Stop After (bottom) → Run/Stop button only (side)** for the TDS784A, and then by pressing the **RUN/STOP** button.

14. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

15. One bit appears in the CH0 output each time the **STEP/EVENT** button on the DG2030 front panel is pressed. Press the **STEP/EVENT** button six times and confirm that the bit pattern: 0 1 0 1 0 1, one bit for every pressing that button, appears.

16. Press the **START/STOP** button on the front panel to stop output (the button's LED goes off).

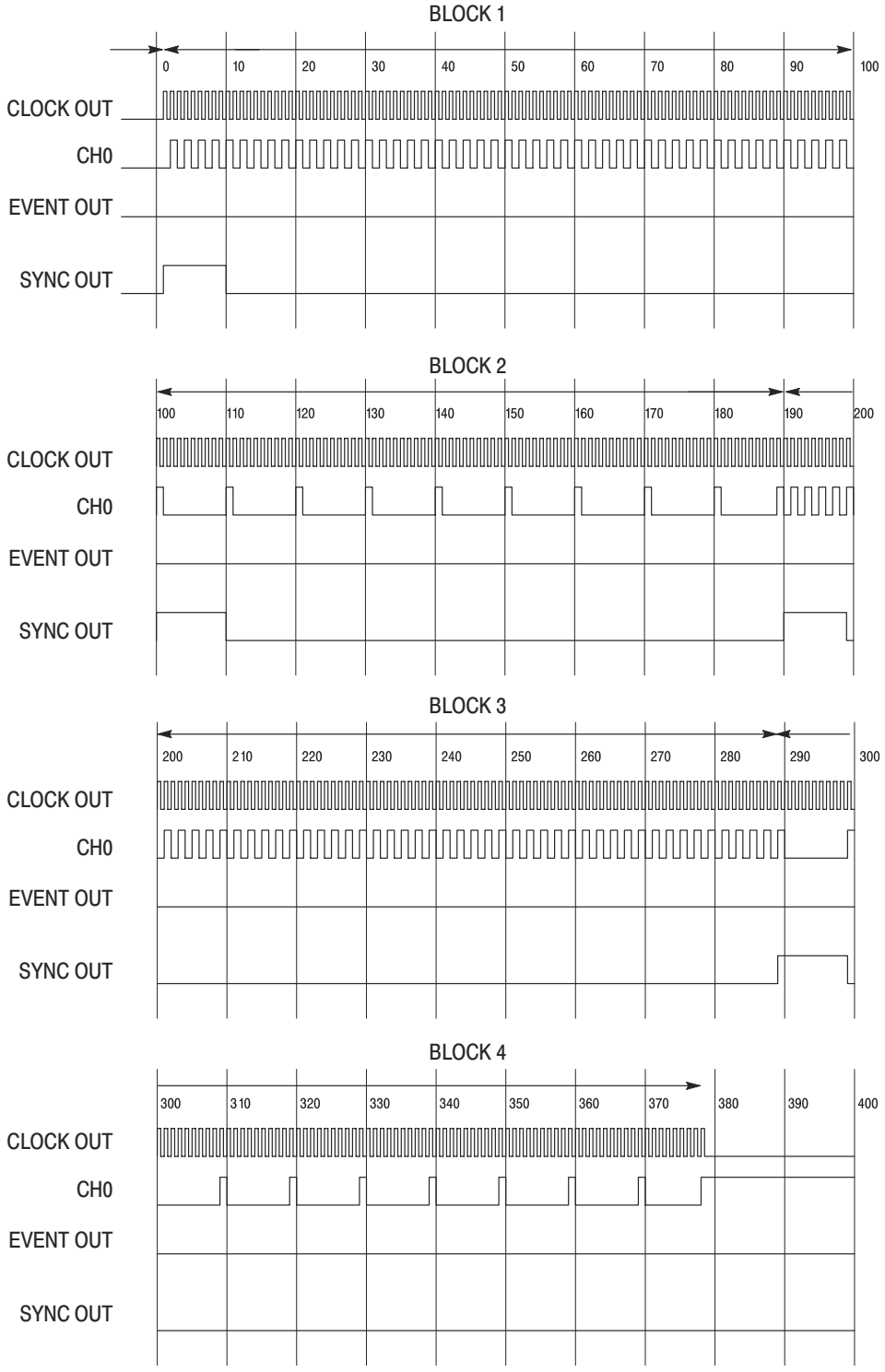


Figure B-7: Single and step mode timing chart

The following steps check the digital pattern output, event output and sync output in Enhanced run mode.

17. Press the following buttons to set the DG2030 run mode to **Enhanced**.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Run Mode		Enhanced	

18. Change the oscilloscope trigger source to CH3 and trigger position to 50 %.

19. Press the following buttons to set the trigger parameters.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Source (Set to Int)	
			Interval	
			State (Set to On)	
			Time	10 kHz/ms/mV

20. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

21. Confirm the following points from the oscilloscope screen:

- The output patterns in the CH0 to CH3 correctly appear as shown in Figure B-8.

  Change the CH0 cable connection to, in turn, from CH1 to CH3 cable connection when you observe the outputs from CH1 to CH3.

- The output patterns in the CH4 to CH7 correctly appear as shown in Figure B-8 if the option 01 has been installed.

  Change the CH3 cable connection to, in turn, from CH4 to CH7 cable connection on the rear panel when you observe the outputs from CH4 to CH7.

- The event signal pattern in the AUX OUTPUT: EVENT outputs correctly, and the event high and low levels are nearly 5 V and 0 V, respectively.
- The sync signal pattern in the AUX OUTPUT: SYNC outputs correctly, and the sync high and low levels are nearly 5 V and 0 V, respectively.
- Change the oscilloscope horizontal setting to 2 ms/div, and confirm that the trigger wait function operates correctly.

  Trigger event is generated in every 10 ms. Confirm that the block pattern (BLOCK 1) waits for the trigger event and then outputs.

22. Press the following buttons to set the DG2030 clock frequency to 409.6 MHz.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Clock		Int FREQ	409.6 MHz/μs

23. Change the oscilloscope horizontal axis setting to 10 ns/div.

24. Confirm that the data pattern in the CH0 to CH3 (also CH4 to CH7 if the option 01 has been installed), EVENT OUT and SYNC OUT can be observed as shown in Figure B-8 on the oscilloscope. Change the channel output connection as needed.

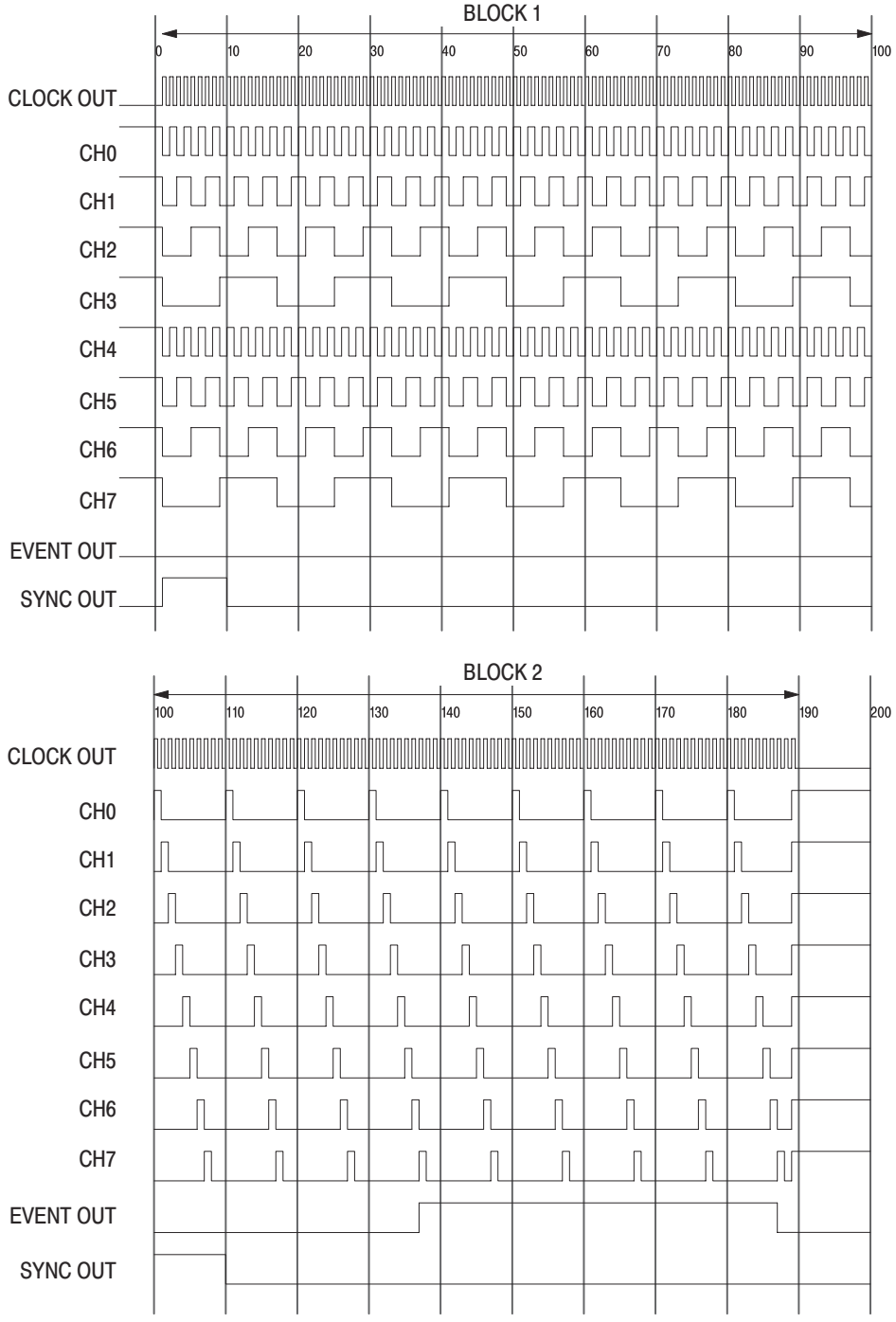


Figure B-8: Enhanced timing chart

The following steps check that the DG2030 internal trigger source generates a 1 μs trigger event every 10 seconds.

25. Press the following buttons to set the DG2030 trigger interval to 1 μs.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Interval	
			State (Set to On)	
			Time	1 MHz/μs

26. Change the frequency settings in the function generator to 1 MHz.

27. Change the oscilloscope horizontal setting to 200 ns/div.

28. Confirm that trigger event is generated in every 1 μs with the oscilloscope screen.

This can be made by confirming that output signal appears on the oscilloscope CH2 in every 1 μs.

29. Press the following buttons to set the DG2030 trigger interval to 10 s.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Interval	
			State (Set to On)	
			Time	10 Hz/s/V

30. Stop acquisition in the oscilloscope, and then change the oscilloscope settings to:

Horizontal axis . . . 5 s/div
Record length 500
Acquisition mode . Single Acquisition Sequence (Stop After menu)
Trigger source CH3

31. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

32. Confirm that there is a 1 μs trigger event every 10 seconds on the oscilloscope channel 2 display.

33. Press the following buttons to set the DG2030 trigger interval to 10 ms.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Interval	
			State (Set to On)	
			Time	10 kHz/ms/mV

34. Press the **START/STOP** button on the front panel to stop output (the button's LED goes off).

The following steps check that the DG2030 turns off the external trigger signal.

35. Load the **TP5EV52.PDA** test pattern file from the performance check disk.

36. Press the following buttons to set the DG2030 clock frequency to 400 MHz.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Clock		Int FREQ	4,0,0,MHz/μs

37. Press the following buttons to turn off the DG2030 trigger interval.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Interval	
			State (Set to Off)	

38. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

39. Make sure that the message *Waiting for Trigger* is displayed at the upper right part of the DG2030 screen and the trigger event no longer occurs.

The following steps check the external trigger signal.

40. Press the following buttons to set the DG2030 trigger source to **Ext**.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Source (Set to Ext)	

41. Change the connection as follows.

a. Disconnect the BNC cable connecting between the DG2030 rear panel EVENT OUTPUT connector and the oscilloscope CH3 input connector.

b. Disconnect the BNC cable connecting between the DG2030 rear panel EVENT INPUT connector and the function generator output connector.

c. Connect a BNC T adaptor to the function generator output connector. And using two BNC cables, connect from the BNC T adaptor to the DG2030 front panel TRIGGER INPUT connector, other side BNC T adaptor to the oscilloscope CH3 input connector.

d. Disconnect the BNC cable from the DG2030 front panel CH3 connector and re–connect it to CH2 connector. (Disconnect the BNC cable from the DG2030 front panel CH7 connector and re–connect it to CH2 connector if the option 01 has been installed.)

e. Disconnect the BNC cable from the DG2030 front panel CLOCK OUT connector and re–connect it to CH0 connector.

See Figure B-9.

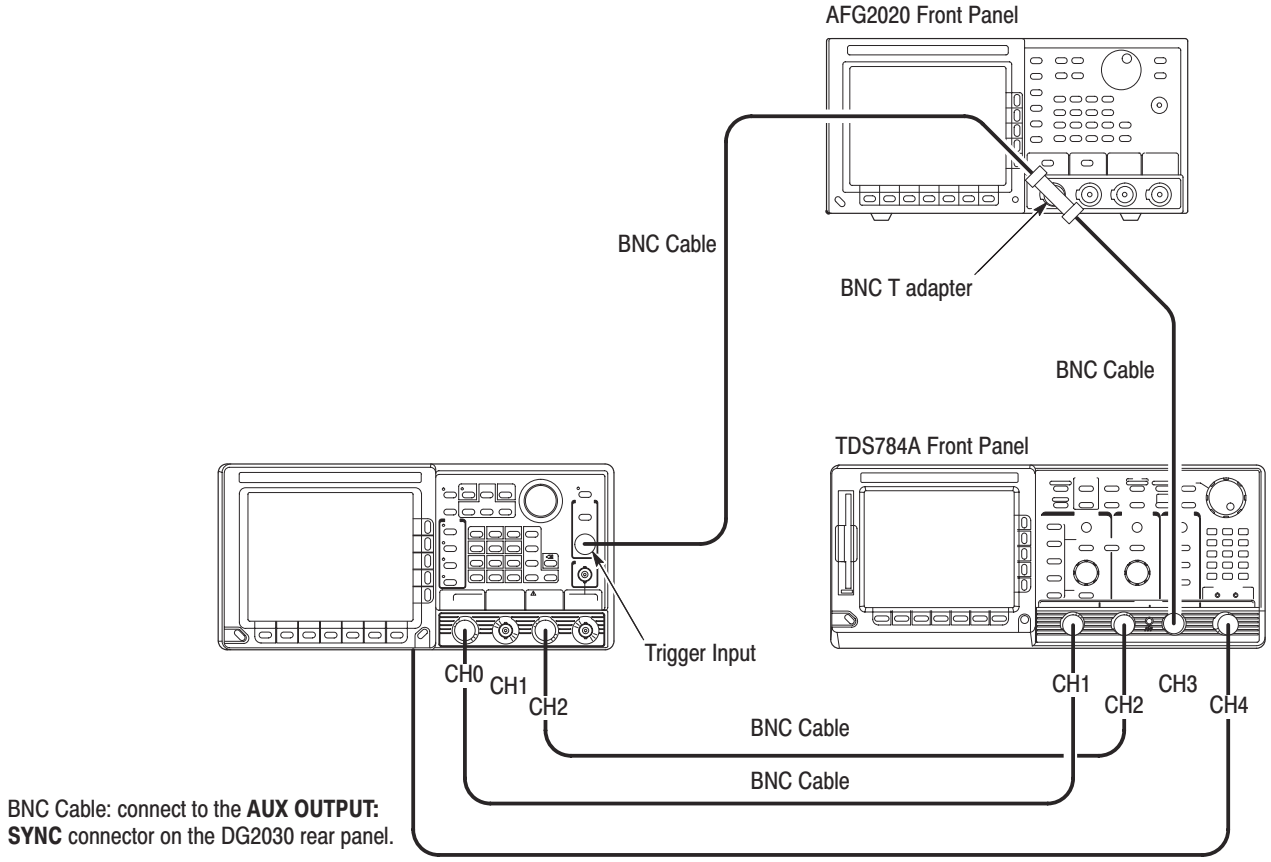


Figure B-9: Sequence & digital output connections #3

42. Press the following buttons to set the DG2030 trigger source to **50 Ω**.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Impedance (Set to 50 Ω)	

43. Set the frequency setting in the function generator to 500 kHz.

44. Set the oscilloscope settings to:

Horizontal axis . . . 400 ns/div
Record length 5000
Vertical axis . . . . . 1 V/div (for CH3 input)
Acquisition mode . Run/Stop button only (Stop After menu)
Input impedance . . 50 Ω (for CH3 input)
Trigger level . . . . . 500 mV
Trigger source CH4

45. Observe the displayed waveform patterns on the oscilloscope screen, confirm that the the trigger event synchronizes with the rising edge of the input pulse.

Trigger event can be recognized by observing the CH1 output signal from the DG2030 on oscilloscope CH1 input.

46. Press the following buttons to set the DG2030 trigger slope to **Negative**.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Trigger		Slope (Set to Negative)	

47. On the oscilloscope screen, confirm that the trigger event occurs synchronizing with the falling edge of the input pulse.

48. Press the **START/STOP** button on the DG2030 front panel to stop output (the button LED goes off).

Inhibit Function

This test confirms the inhibit function of the DG2030 outputs.

Equipment Required	Oscilloscope
	Three BNC cables
	Performance check disk

Connections. Connect the CH1 output from the DG2030 front panel to the inhibit input on the DG2030 rear panel using the BNC cable. Connect the DG2030 front panel CH2 output to the oscilloscope CH1 input. Connect the sync output from the DG2030 rear panel to the oscilloscope CH4 input. See Figure B-10.

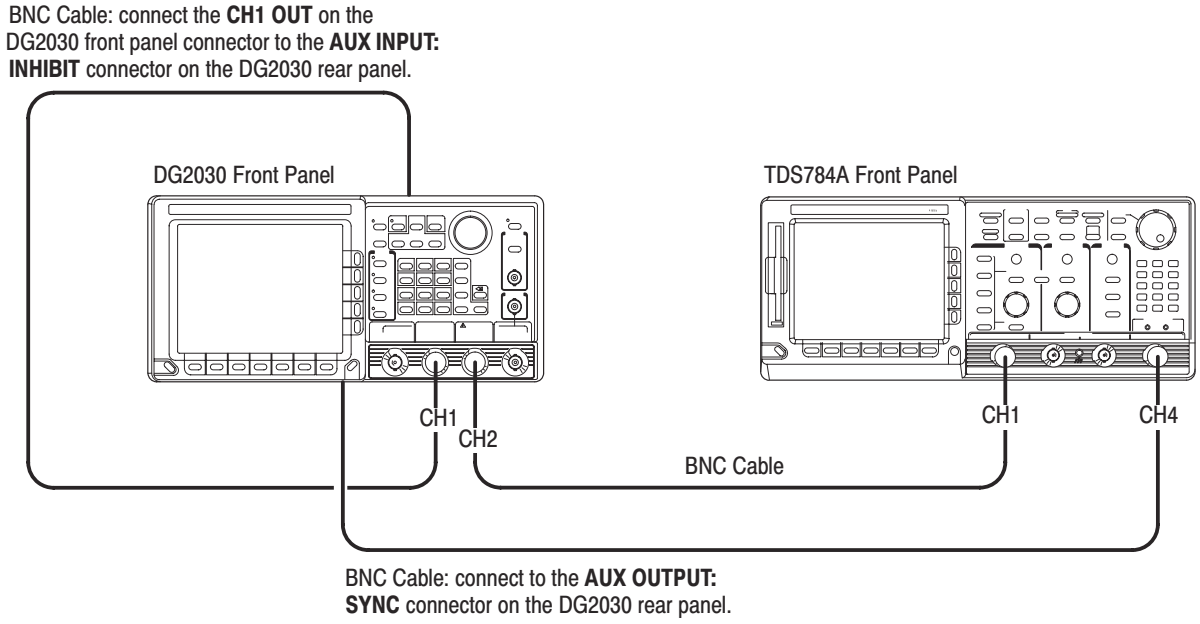


Figure B-10: Inhibit function test connection

Setup.

- Oscilloscope

  Input coupling . . . . DC
  Input impedance . . 50 Ω
  Trigger source CH4
  Trigger mode . . . . Auto
  Trigger level . . . . . 2 V

Characteristics Confirmation Procedure.

1. Load the **TP6INH.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.
3. Confirm that the pulse pattern waveform with 5 MHz of frequency, +3 V of high voltage level and 0 V of low voltage level is continuously output from the DG2030 CH2 output.

NOTE. *The first pulse, which has +3 V of high voltage level, after the sync signal went to high level state will have narrower pulse width than other pulses. This is because that the delay time of the external inhibit signal is larger than that of the internal inhibit signal.*

---

4. Change the BNC cable connection from the DG2030 front panel CH2 to the DG2030 CH3 connector, and then confirm the CH3 output waveform as was done in step 3.

   When the option 01 has been installed, confirm the output waveforms from CH4 through CH7 as changing the BNC cable connection.
5. Change the BNC cable connection from the DG2030 CH3 (or CH7) connector to the DG2030 CH0 connector.
6. Confirm that the DG2030 outputs twenty-five 5 MHz pulses with a high value of +3 V and a low value of –1 V, followed by twenty-five 5 MHz pulses with a high value of 0 V and a low value of –1 V. These two waveform patterns are continuously and repeatedly output from CH0.
7. Change the BNC cable connection from the DG2030 front panel CH1 connector to the DG2030 CH2 connector, and then the CH0 to CH1 connector.
8. Confirm that the DG2030 outputs twenty-five 5 MHz pulses with a high value of 0 V and a low value of –1 V, followed by twenty-five 5 MHz pulses with a high value of +3 V and a low value of –1 V. These two waveform patterns are continuously and repeatedly output from CH1.
9. Change the BNC cable connection from the DG2030 CH1 output to clock output on the front panel.

10. Set the inhibit control for the CH2 output channel to **OFF** as following procedures:

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP				
Select CH2 with the general purpose knob.				
	Output Condition		Control Condition	
			Change Inhibit Control	
		OFF		
			OK	

11. Confirm that the clock output voltage level is almost 0 V.

12. Disconnect the BNC cable from the inhibit input on the DG2030 rear panel.

13. Confirm that the pulses with 10 MHz of frequency, +3 V of high voltage level and –1 V of low voltage level are continuously output from the DG2030 clock output.

14. Press the **START/STOP** button on the front panel to stop output.

Output Level, Amplitude, Rise Time and Fall Time Accuracy

This test confirms the output level, amplitude, rise time and fall time accuracies of the DG2030 output.

Variable voltage levels for the amplitude

High level: –1.25 V to +3.50 V into 50 Ω
Low level: –1.50 V to +3.25 V into 50 Ω

Output Level (CH0 to CH7)

Accuracy: ±(3 % of setting) ±50 mV into 50 Ω

Output Amplitude (CLOCK OUT)

Accuracy: ±(5 % of setting) ±50 mV into 50 Ω

Rise / Fall Times

Accuracy: ±(10 % of setting) ±500 ps

Equipment Required	Digital multi–meter (DMM)
	Oscilloscope
	BNC cable
	Precision 50 Ω termination
	BNC to dual banana adapter
	Performance check disk

Connections. Connect the CH0 output from the DG2030 front panel to the digital multi–meter input using the BNC cable, precision 50 Ω termination and BNC to dual banana adapter as shown in Figure B-11.

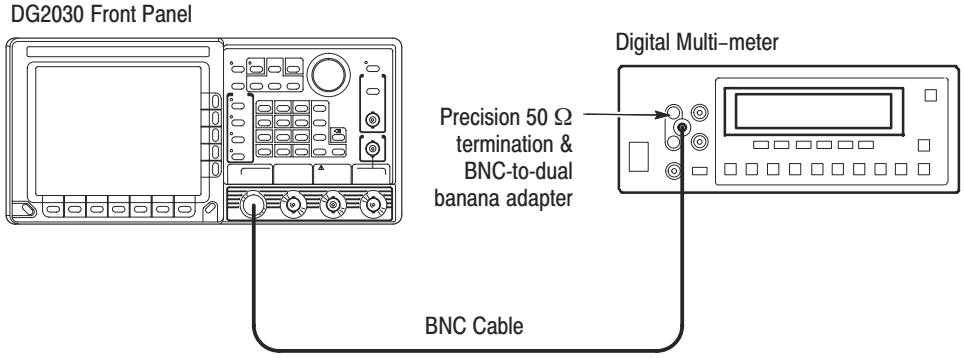


Figure B-11: Output level measurement connections

Setup.

- Digital multi–meter

  Function . . . . . DCV
  Range . . . . . Auto

- Oscilloscope

  Vertical axis . . . . . 500 mV/div
  Horizontal axis . . . . . 2 ns/div
  Trigger source CH1
  Trigger level . . . . . 750 mV
  Display channel CH1
  Input coupling . . . . . DC
  Input impedance . . . . . 50 Ω
  Bandwidth . . . . . Full
  High Ref. (Rise/Fall Times) . . 80 %
  Low Ref (Rise/Fall Times) . . . 20 %

Characteristics Confirmation Procedure.

1. Load the **TP7LVL.PDA** test pattern file from the performance check disk.

The following steps check the high voltage levels on all output channels.

2. Press the following buttons to set the DG2030 high and low voltage levels.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Level Condition			
Move the cursor to CH0 with the general purpose knob.				
			High	–1.25 ENTER
			Low	–1.50 ENTER

Note that the low level is automatically set to –1.50 V when the high level has been set to –1.25 V.

3. Press the **START/STOP** button on the front panel so that the button's LED indicator lights.

4. Confirm the high voltage level as following procedures:

   a. Press the **STEP/EVENT** button on the DG2030 front panel once to output high voltage level.

   b. Set the high and low voltage levels to the values indicated in Table B-5, and confirm that the digital multi–meter reading for each high voltage level setting falls within the specified voltage range.

   c. Repeat step b for all high and low voltage settings in Table B-5.

   d. Repeat steps from a to c for all output channels from CH0 to CH3 (or to CH7 if the option 01 has been installed) as changing the BNC cable connection.

Table B-5: High level output voltage accuracy

Settings		
High voltage level (V)	Low voltage level (V)	High level output voltage ranges
–1.25	–1.50	–1.337 V to –1.163 V
0	–1.50	–0.050 V to +0.050 V
+1.00	–1.50	+0.920 V to +1.080 V
+2.00	–1.50	+1.89 V to +2.11 V
+3.50	–1.50	+3.35 V to +3.65 V

5. Confirm the low voltage level as following procedures:

   a. Press the **STEP/EVENT** button on the DG2030 front panel once to output low voltage level.

   b. Set the low and high voltage levels to the values as shown in Table B-6, and confirm that the digital multi–meter reading for each voltage setting falls within the specified voltage range.

   c. Repeat step b for all high and low voltage settings in Table B-6.

   d. Repeat steps from a to c for all output channels from CH0 to CH3 (or to CH7 if the option 01 has been installed) as changing the BNC cable connection.

Table B-6: Low level output voltage accuracy

Settings		
Low voltage level (V)	**High voltage level (V)**	**Low level output voltage ranges**
–1.50	+3.50	–1.595 V to –1.405 V
0	+3.50	–0.050 V to +0.050 V
+1.00	+3.50	+0.920 V to +1.080 V
+2.00	+3.50	+1.89 V to +2.11 V
+3.25	+3.50	+3.11 V to +3.39 V

The following steps check the clock output amplitude accuracy.

6. Disconnect the BNC cable from both the digital multi–meter input and the DG2030. And then connect the clock output to the oscilloscope CH1 input as shown in Figure B-12.

7. Load the **TP8PULSE.PDA** test pattern file from the performance check disk.

8. Using the oscilloscope measurement functions, perform the measurements under the low and high voltage level settings shown in Table B-7, and confirm that the amplitude for each voltage setting is within the specified range.

Table B-7: Output amplitude accuracy

Settings		
Low voltage level (V)	**High voltage level (V)**	**Amplitude ranges**
–1.50	–1.25	0.188 V to 0.312 V
–1.50	–0.50	0.90 V to 1.10 V
–1.50	+0.50	1.85 V to 2.15 V
–1.50	+1.50	2.80 V to 3.20 V
–1.50	+2.50	3.75 V to 4.25 V
–1.50	+3.50	4.70 V to 5.30 V

The following steps check the rise and fall time accuracies for the clock output and data outputs on all channels.

9. Using the oscilloscope measurement functions, perform the clock signal rise and fall time measurements under the low and high voltage level, and rise and fall time settings indicated in Table B-8, and confirm that the measurement results are within the specified range.

Set the oscilloscope trigger slope to Positive for observing the pulse rising slope, and to Negative for the pulse falling slope.

Table B-8: Rise and fall time accuracies

Voltage settings			
Low level	**High level**	**Rise/fall times**	**Rise/fall time ranges**
–1.50 V	+0.50 V	2.24 ns	1.52 ns to 2.96 ns
		3.10 ns	2.29 ns to 3.91 ns
–1.50 V	+1.50 V	3.42 ns	2.58 ns to 4.26 ns
		4.72 ns	3.75 ns to 5.69 ns
–1.50 V	+2.50 V	4.58 ns	3.63 ns to 5.53 ns
		6.36 ns	5.23 ns to 7.49 ns
–1.50 V	+3.50 V	5.74 ns	4.67 ns to 6.81 ns
		8.00 ns	6.70 ns to 9.30 ns

10. Change the BNC cable connection from the clock output to CH0 through CH3 (or CH7 for option 01) in turn, and repeat step 9 for each of these channels. Confirm the rise and fall times are within the specified ranges.

11. Press the **START/STOP** button on the front panel to stop output (the button's LED goes off).

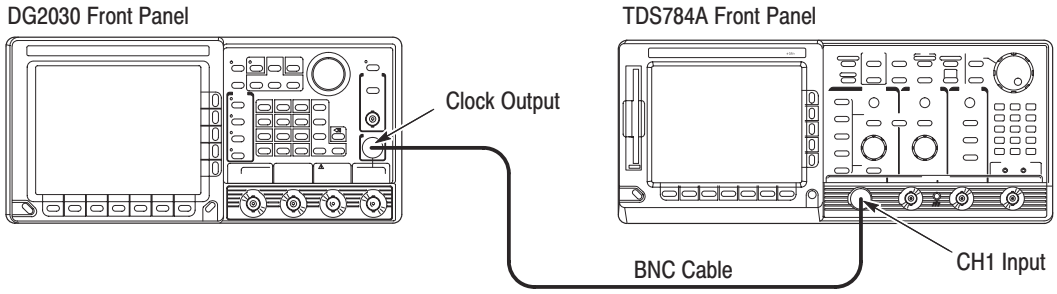


Figure B-12: Output amplitude, rise time and fall time measurement connection

Delay Time Accuracy

This test confirms the delay time accuracy referenced to the clock output on each channel and the channel skew of the DG2030.

Accuracy: ±(3 % of setting) ±500 ps
±60 ps × | Ambient temperature (°C) − 25 |

Equipment Required	Oscilloscope
	Two BNC cables
	Performance check disk

Connections. Connect the clock and CH0 outputs from the DG2030 front panel to the oscilloscope CH1 and CH2 inputs, respectively, using the BNC cables. See Figure B-13.

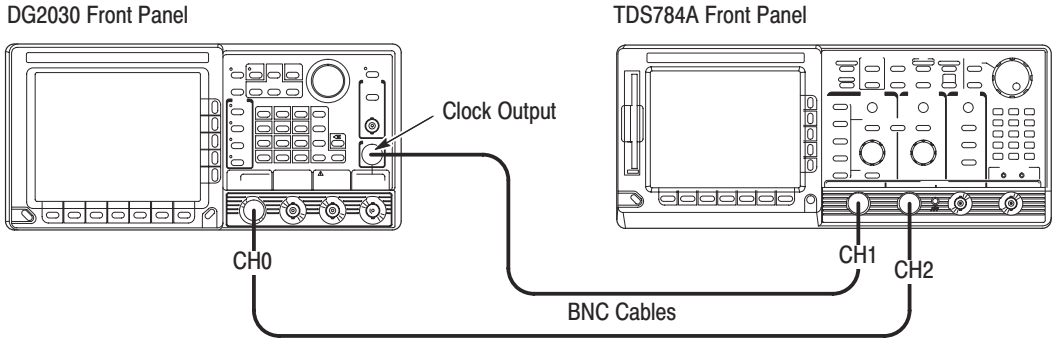


Figure B-13: Delay time measurement connections

Setup.

- Oscilloscope

Displayed channel	CH1 and CH2
Vertical axis	500 mV/div
Horizontal axis . . .	5 ns/div
Trigger mode	Auto
Trigger source	CH1
Trigger level	750 mV
Input coupling	DC
Input impedance . .	50 Ω

Characteristics Confirmation Procedure.

1. Load the **TP8PULSE.PDA** test pattern file from the performance check disk.
2. Press the **START/STOP** button on the front panel so that the button LED indicator turns on.
3. Press the following buttons to set the DG2030 CH0 output delay time to –5.00 n.

Menu button	Bottom button	Pop up menu	Side button	Front panel button
SETUP	Timing Condition			
Move the cursor to CH0 with the general purpose knob.				
			Delay	–5.0 ENTER

4. Set the delay time to –5.00 ns, 0.00 ns, +5.00 ns, +10.00 ns, +15.00 ns and +18.00 ns in turn. Perform the delay time measurement for each delay time setting with the oscilloscope. Confirm that the data output delay times referenced to the clock signal are within the specified range for each of these delay time settings.

5. Change the BNC cable connection from the CH0 to CH1 through CH3 for standard (or CH7 for option 01) in turn and repeat step 4 for each of these channels.

6. From above measurement results at 0.00 ns delay time setting on all output channels, confirm that the delay time differences between two adjacent channels is within the range from –300 ps to +300 ps.

7. Press the **START/STOP** button on the front panel to stop data output (the button's LED goes off).

Appendix C: Miscellaneous

This appendix covers the following items.

- Repackaging for Shipment
- Inspection and Cleaning
- Factory Settings
- Conversion Table Examples

Repackaging for Shipment

If this instrument is shipped by commercial transportation, use the original packaging material. Unpack the instrument carefully from its shipping container so that the carton and packaging material can be used for repackaging.

If the original packaging is unfit for use or is not available, repackage the instrument as follows:

1. Obtain a corrugated cardboard shipping carton having inside dimensions at least six inches greater than the instrument dimensions and having a carton test strength of at least 125 kg (275 pounds).
2. If the instrument is being shipped to a Tektronix Service Center for repair or calibration, attach a tag to the instrument showing the following: the owner of the instrument (with address), the name of a person at your firm who may be contacted if additional information is needed, the complete instrument type and serial number, and a description of the service required.
3. Wrap the instrument with polyethylene sheeting or equivalent to protect the outside finish and prevent entry of packing materials into the instrument.
4. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing for three inches of padding on each side (including top and bottom).
5. Seal the carton with shipping tape or with an industrial stapler.
6. Mark the address of the Tektronix Service Center and your return address on the carton in one or more prominent locations.

Inspection and Cleaning Procedures

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. *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

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.

Factory Settings

When **Reset to Factory** is selected from the **UTILITY System** menu, this instrument's parameters are reset to the values they had when leaving the factory. Table C-2 lists these factory settings.

Table C-2: Factory settings

SETUP menu	
Output Condition	
Event Level	1.4 V
Event	Enable
Inhibit Level	1.4 V
Inhibit Control (Change Inhibit Control)	OFF
Level Condition	
High	1.5 V (into 50 Ω) (for all channels)
Low	0.0 V (for all channels)
Z on Stop	On
Timing Condition	(for all channels)
Rise	FAST
Fall	FAST
Delay	0.0 ns
Run Mode	
Run mode	Repeat
Update	Auto
Trigger	
Slope	Positive
Level	1.4 V
Impedance	1 kΩ
Source	Ext
Interval → State	Off
Interval → Time	10.0 s
Clock	
Source	Int
Int FREQ	100.00 MHz
Ext FREQ	100.00 MHz
PLL	On

Table C-2: Factory settings (Cont.)

UTILITY menu	
Mass Memory	
Special → Catalog Order	NAME1
Display	
Clock	Off
Brightness	70%
Dimmer	Off
Hardcopy	
Format	BMP
Port	DISK
System	
Power up Pause	On
Diag	
Type	All
De-skew	
Skew	0.0 ns (for all channels)

The following menu items are not affected by **Reset to Factory**.

- Menu items in the **EDIT** menu
- The following **SETUP** items

  Group number
  Channel allocation

  However, when **Security Immediate** item is selected in the **UTILITY System** menu, the above items are reset.

- The following **UTILITY** items

  Remote Port
  GPIB operation mode and address
  Serial parameters
  Date/Time

Conversion Table Examples

Using the code conversion table, bit pattern can be converted to another. Figure C-1 shows an image how the code conversion table is used.

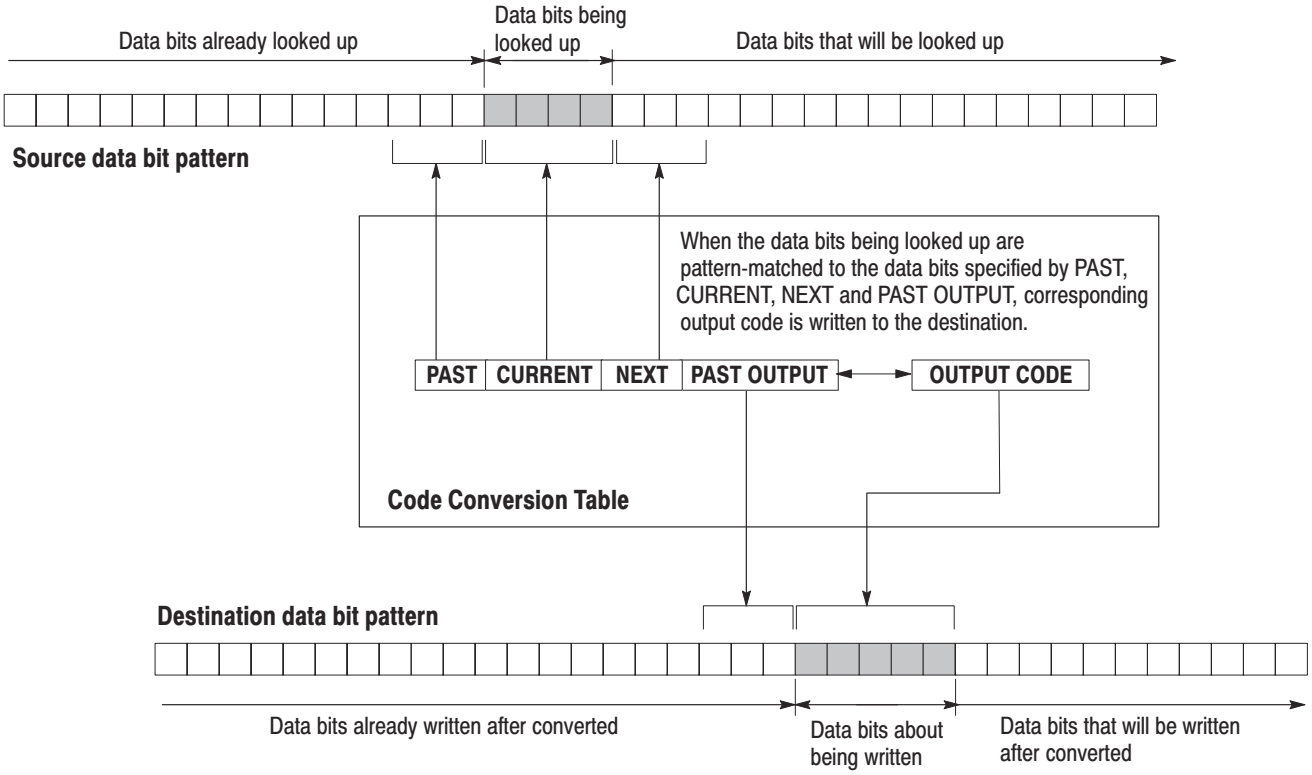


Figure C-1: Conversion image example

Examples

In following examples, data bits to be written in the tables are introduced. And input and output data bit pattern example is following 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

- Converting NRZ data to **NRZI**. Two bit 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 bit 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 bit are generated for each input bit.

Past	Current	Next	P. OUT	Output code
	0			01
	1			10

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 bit 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

- 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
	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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